

# Popular Mechanics

MARCH 1989 \$1.95

## SUPER PLANE!

Boeing's Astounding New Jumbo Jet Carries More Passengers And Flies Them Farther Than Any Other Plane In History

**EXTRA!**

**INVESTIGATING  
PAN AM'S SCOTTISH  
AIR DISASTER**

**PLUS**

**747 FOLDOUT  
POSTER**

Cordless Drills

**JOIN THE FAX  
REVOLUTION**

New Machines Are Lower  
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**SPORT/UTILITY SPECIAL**  
Tests • 4wd Tech • Fixes • More

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- Tune Up Your Garden Tools For Spring
- Garden Tiller Test
- Plans Offer:  
Build Our Distinctive  
Stone Utility Shed





# FORD'S NEWEST FORM

## THE NEWLY DESIGNED 1989 FORD BRONCO II.

It'll take you through some heavy rush hour traffic or across some shallow rapids. And with its new aerodynamic design you'll

want it to take you everywhere. It's the rugged, stylish Ford Bronco II. **NO NEED TO BEAT AROUND THE BUSH.**

Bronco II has standard V-6 fuel-injected power for the open road and standard anti-lock rear brakes

to help you when the open road gets crowded. Even when the road ends, Bronco II's optional "Touch Drive" lets you shift into 4-wheel drive and move ahead with the press of a button. There's available 2-wheel drive, also.



### MODELS

Eddie Bauer...design edition.  
XL Sport...sporty performance look.  
XLT...popular value package.  
XL...fun-to-drive action.

### MAJOR STANDARD EQUIPMENT

Power Steering; Power Brakes (rear anti-lock);  
Gauge Package (fuel, temp., oil); AM/FM  
Stereo w/Clock; P205 15" All Season Radials;  
Gas-Pressurized Shocks.

### DRIVETRAINS

2.9L EFI V-6; 5-Speed Manual O.D.;  
4-Speed Column-Mounted Auto O.D. Opt.

### MAXIMUM TRAILER WEIGHT RATING

2WD Model-5000 lbs.; 4WD Model-4900 lbs.





# OF RAPID TRANSIT.

## NO NEED TO SACRIFICE COMFORT.

Bronco II's available Eddie Bauer Package includes specially designed upholstery and paint and the added comfort of Captain's Chairs. Bronco II's redesigned instrument



panel and available column shift automatic transmission are only two of the features that make for a comfortable new interior environment. Any way you look at it, the newly designed Bronco II has style and comfort to spare.

## 6/60 WARRANTY.

Covers you and future owners, with no transfer cost, on major powertrain components for 6 years/60,000 miles. Restrictions and deductible apply. Also, participating dealers back their customer-paid work with the Lifetime Service Guarantee. If a covered repair must be fixed again, the repairing dealer will fix it free for as long as you own your vehicle.\*

## FORD. BEST-BUILT AMERICAN TRUCKS 8 YEARS RUNNING.

Based on an average of owner-reported problems in a series of surveys of '81-'88 models designed and built in North America. At Ford, "Quality is Job 1."

\*Ask to see these limited warranties at your Ford Dealer.

Buckle up—together we can save lives.

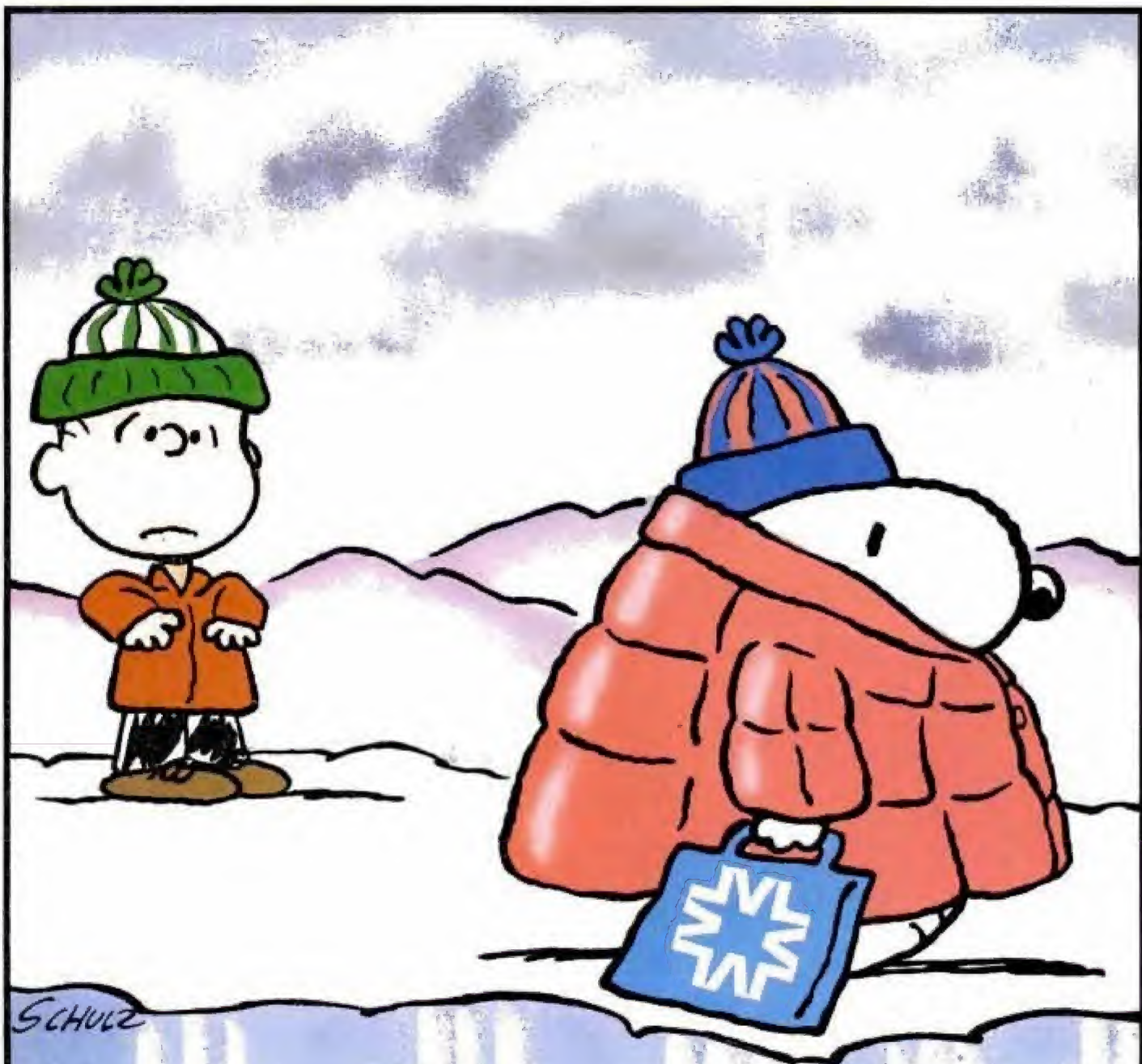


**BRONCO II**  
BUILT FUN TOUGH



UHYR-7EP-X4U2





YOU CAN NEVER BE TOO SNUG OR TOO SECURE.

...particularly in today's fickle financial climate.

**GET MET. IT PAYS.**







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Here's a look at aviation's future, the 747-400. And a glimpse at its past—this cruise ship of the sky represents almost two decades of progress in the air.  
—PM illustration by Attila Hejja



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# EDITOR'S NOTES

## Popular Mechanics

**W**E HAD BEEN working on this month's cover story (page 74) for several months before news reached us of the Pan Am Flight 103 tragedy in Lockerbie, Scotland. Although our article was about the new Boeing 747-400 just going into service, and Flight 103's equipment was an early 747-100, still, the Dash 400 is a descendant of the plane that went down. We wondered what to do, since a possible mid-air breakup caused by mechanical failure was, at first, one of the possible causes mentioned for Flight 103's demise. Contributing Editor Fred Mackerodt had, just days before, visited Pan Am's giant maintenance facility at New York's John F. Kennedy International Airport as part of the research for our article. Mackerodt, a licensed pilot himself (multi-engine, instrument rated), watched Pan Am's machinists, mechanics, painters, upholsterers and avionics technicians swarming over a gutted 747 as they performed a D-Check. It takes 223 craftsmen two months to complete a D-Check. The operation, which is performed every five years on every 747, makes each



The sign says "High Speed Test Track."

plane virtually a brand-new aircraft. When the initial speculation surfaced that Flight 103 had possibly disintegrated in flight because of some structural failure or mechanical defect, Mackerodt told me immediately that there was no way. By inference, such speculation cast doubt on the skilled people who keep these planes flying, and Mackerodt wasn't buying it. Now, of course, we know that it wasn't a mechanical defect that brought down Flight 103. It was a mental defect that led some deranged person or persons to believe that killing 259 fellow human beings in cold blood could be the answer to anything. . . . On a happier note, I was on a 747 myself recently to travel to Japan to drive Nissan's new 300ZX at Nissan's home proving grounds in Tochigi. The 14-hour flight in a 747SP was as comfortable as a long-haul 14-hour flight can be and a hell of a lot less exciting than Nissan's new world-class sports car. My comments are part of our 1989½ new-car report which begins on page 61. . . . Sure, we could have rounded up every sport/utility vehicle known to man, found some sand dunes in California, blasted around for a few days, then reported our findings to you. And we did, as part of this month's Sport/Utility Special Section. But we added one



Taylor, Millen and Swan in the dunes.

twist: Champion off-road racer Rod Millen joined our Auto Editor Tony Swan, Contributing Editor Rich Taylor, and the rest of our auto editors to bring you the best possible information on these vehicles. Check it out on page 109. 'Til next time.

*Joe Oldham*  
Joe Oldham

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# LETTERS

## A Vote For The Vette

**I** AM A longtime fan and reader of your magazine and appreciated the technical aspects of Tony Swan's article on the ZR1 Corvette in the January issue ("Motown Muscle," page 53). I do have a bone to pick with him, however. Having owned four Vettes in my lifetime, including two 1969 L88 427s, I disagree with his comment about some Vettes being "crude, noisy and about as much fun to drive on the street as dumptrucks."

The Corvette has always been, and probably always will be one of the premier engineering feats of American know-how. The particular range of my experience was from 1964 to 1975 models, and in spite of the fact that a majority of police will follow you closely as you pass through their hamlets, driving the Corvette was pure pleasure.

Too bad that many people who could really appreciate the technical power and innovation of the beautiful machine called the ZR1 can't afford it.

FRANK L. KIHN  
BAYFIELD, CO

### A Bit Of Advice

As an avid reader of PM for over 50 years, I've especially enjoyed articles on specific tools, the latest being on the router and bits ("Mastering The Router," page 75, Jan. '89 and "Router Bits," page 65, Feb. '89).

I would like to share a little trick. When using a piloted bit, especially on plastic laminates, instead of cleaning with thinner and then having to lubricate it, try using WD40. It cleans beautifully and lubricates. I have yet to burn out a bearing.

JOSEPH J. INCANTALUPO  
YORKTOWN HEIGHTS, NY



"Motown Muscle" story, with reports on Corvette and other hot Detroit power players, was opening feature in PM's Jan. '89 Stealth Fighter issue.

### Keep It Clean

In your story, "How To Choose A Water Filter" (page 117, Aug. '88) you should have included the carbon block filter system which has been on the market for 18 years or more. I am a distributor for Multi-Pure which makes a carbon filter system. I hope you'll do a followup on how to choose a water filter.

JACK WITTENBERG  
NEW BALTIMORE, MI

There are literally hundreds of brands of activated-charcoal water filters on the market. It would be impossible for us to list all of them. Unfortunately for the homeowner, there is no comprehensive guide to home water filters. An EPA listing is no assurance of good performance—it merely indicates that the manufacturer has registered his product with the EPA. Perhaps the most complete listing of tested water filters is one available from the National Sanitation Foundation, a nonprofit industry organization, located at 3475 Plymouth Rd., P.O. Box 1488, Ann Arbor, MI, 48106. This listing, the Annual Listing of Drinking Water Treat-

ment Units, is published yearly and updated during the year with supplements. It costs \$8, but you may find it at your local public library.

You mention that activated charcoal in a water filter bonds strongly to impurities and is effective in removing radon. My question is whether activated-charcoal filters can adsorb sufficient amounts of radon to become a radioactive hazard both in the home and also when the filter becomes loaded with contaminants and must be disposed of?

JOHN LAMBRUKOS, M.D.  
CONCORD, NH

*While an activated-charcoal filter will, indeed, adsorb and concentrate radon, it's not apt to present any radioactivity or health problems. The radiation emitted by radon only presents a serious threat to health when airborne radon decomposition products lodge in the lungs.*

*As a consequence, the major health hazard of radon in water occurs when the radon gas escapes to the air and is breathed. Radiation from radon trapped inside a filter is blocked harmlessly by the filter material itself.*

*Further, there's no real risk of an excessive radon buildup within the filter causing filter disposal problems. Radon decomposes in a matter of days, so old radon is constantly disappearing from the filter as new radon is adsorbed.*

### Hotline Hurrahs

I've enjoyed your magazine for many years. The do-it-yourself articles are always interesting and helpful and I especially enjoy the "Clinic" columns. PM always has the right answer to the many problems that are sent to

"Car Clinic" and I find it very interesting and helpful. Your latest service—the Hotline—where we can talk to an editor is the greatest! I had a problem with my 1984 Nissan Pulsar which the dealer could not fix. I called you right away and after discussing my problem, got possible solutions which I referred to my dealer. Thanks to POPULAR MECHANICS, the car is now running like new.

ANTHONY J. PACIFICO  
MADISON, NJ

Just a note to compliment you on your new call-in advice program, and tell other readers that I received great advice regarding my brake problem—rear brake lockup after a front brake job by a major chain repair operation. When I took the car back, they advised, "we tightened rear shoes—everything else okay."

When I got home the rear drums were practically red hot, and the car wouldn't even coast down a good grade. I loosened up rear shoes (had to remove wheels since Chevette has no adjustment holes. The shop had things too tight and probably didn't want to remove the wheels to loosen the adjustment).

Anyway, per your advice on the phone, I rebled the lines. Everything is perfect now. I can't thank POPULAR MECHANICS enough for this sound advice after my brake job runaround.

CHARLESSEFELDT  
BRADENTON, FL

*In addition to our Hotline phone numbers, POPULAR MECHANICS now offers an electronic mail service via personal computer and modem. See page 138 for all the details.*

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**Add it up for yourself.**

There are two very good reasons why Ford Escort adds up to such an attractive value. (1) An actual comparison proves that Escort gives you more features for less money than the imports.\* (2) It's the world's best-selling car six years running (based on '82-'87 calendar year worldwide sales and export data). And they both add up to the kind of attractive value you can take to the bank.

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Covers you and future owners, with no transfer cost, on major powertrain components for 6 years/60,000 miles. Restrictions and deductible apply.

Also, participating dealers back their customer-paid work with the Lifetime Service Guarantee. If a covered repair must be fixed again, the repairing dealer will fix it free for as long as you own your vehicle. Ask to see these limited warranties at your Ford Dealer.

**Best-built American cars...eight years running.**

For the past eight consecutive years, Ford quality has led all other American car companies. That's based on an average of owner-reported problems in a series of surveys of '81-'88 models designed and built in North America. At Ford, "Quality is Job 1."

\*Based on comparison of latest available sticker prices. Escort includes special value package 321A and selected option items. Value package may vary. See your dealer about the package in your area.

# Count on Ford Escort to offer more features for less money than the imports.



**Buckle up—together we can save lives.**



---

**NISSAN  
SENTRA XE**

---

1. 1.6L SOHC Engine
2. Automatic Transaxle
3. Power Steering
4. Electronic AM/FM Stereo Radio
5. Electronic Digital Clock
6. Tinted Glass
7. Reclining Bucket Seats
8. Tilt Steering Wheel
9. Rear Window Defroster
10. Light Group
11. Interval Wipers

---

**TOYOTA  
COROLLA DELUXE**

---

1. 1.6L Engine
2. Automatic Transaxle
3. Power Steering
4. Electronic AM/FM Stereo Radio
5. Electronic Digital Clock
6. Tinted Glass
7. Reclining Bucket Seats
8. Tilt Steering Wheel
9. Rear Window Defroster
10. Light Group
11. Split Fold Down Rear Seat

---

**HONDA  
CIVIC DX**

---

1. 1.5L SOHC Engine
2. Automatic Transaxle
3. Power Steering
4. Electronic AM/FM Stereo Radio
5. Electronic Digital Clock
6. Tinted Glass
7. Reclining Bucket Seats
8. Tilt Steering Wheel
9. Rear Window Defroster
10. Light Group
11. Instrumentation Group
12. Interval Wipers

---

**FORD  
ESCORT LX**

---

1. 1.9L SOHC EFI Engine
2. Automatic Transaxle
3. Power Steering
4. Electronic AM/FM Stereo Radio
5. Electronic Digital Clock
6. Tinted Glass
7. Reclining Bucket Seats
8. Tilt Steering Wheel
9. Rear Window Defroster
10. Light Group
11. Instrumentation Group
12. Split Fold Down Rear Seat
13. Interval Wipers
- And Still Counting...**
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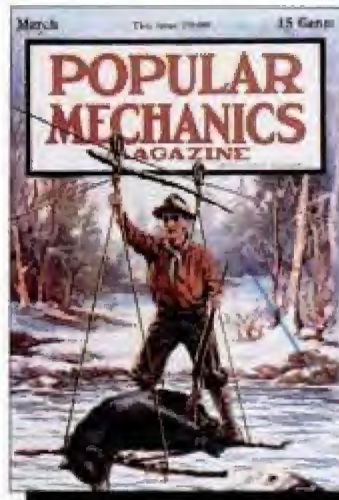
**Have you driven a Ford...lately?**





# TIME MACHINE

75 YEARS AGO: MARCH 1914

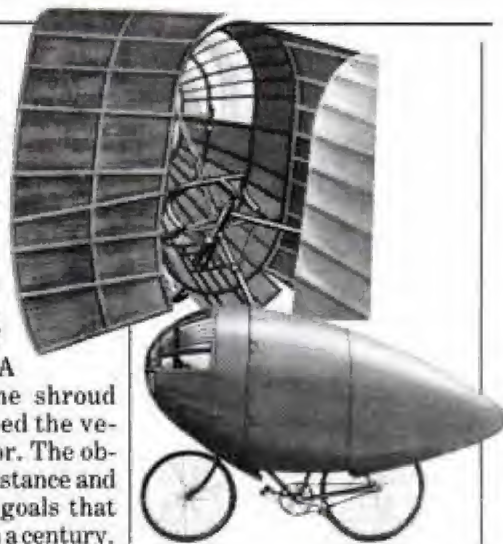


## Mechanical Advantage

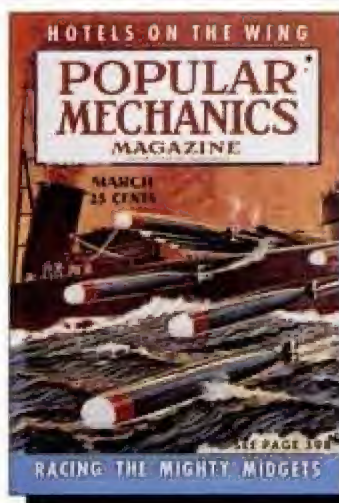
Hunting for sport was fast overtaking hunting for food in the vast tapestry of man's evolution. And with this shift in priority came technological innovation that made hunting easier and more productive. Firearms were lighter, clothing warmer. As our cover illustrated, a knack for invention was also being brought to bear. Our huntsman rigged an "aerial railway" across a river in New York's Adirondack region to bring back the kill.

## Bullet Bike

In an age when aeronautical advancement was making the daily headlines, aerodynamics technology found a natural place in more terrestrial pursuits. One spinoff was the aerobike. A canvas-over-frame shroud completely encased the velocipede's operator. The object: Cut wind resistance and vortices—design goals that haven't changed in a century.



50 YEARS AGO: MARCH 1939



## Seapower

Ominous signs of an impending European conflict focused PM's attention a half century ago on weapons of war. One example: The latest contribution to Britain's naval might was the torpedo destroyer, which ripple-fired swarms of ordnance from twin sets of swiveling tubes amidships. Navy planners decided that a salvo of munitions—in an age before the advent of highly accurate digital fire control—was the best way to achieve a direct hit on the high seas.

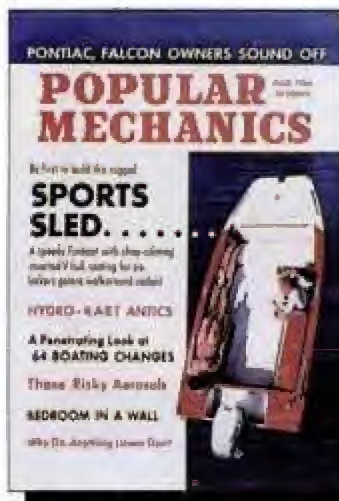
## Just The Fax

Today's telephone-line facsimile machines were predat-



ed by experimental radio facsimile devices that broadcast newspapers to home receivers. This St. Louis Post-Dispatch experiment to speed communication was driven by rather unwieldy transmitting devices that scanned specially prepared news, weather, sports and photos as they revolved 75 times per minute on a drum. A photoelectric eye detected the changes in the input contrast, altering the radio-frequency output, which etched the information on home test receivers.

25 YEARS AGO: MARCH 1964



## Boat Boom

No longer the exclusive domain of well-heeled connoisseurs, the pleasures of boating were becoming available to more and more people in the post-war pursuit of recreation. Right in the thick of it, PM supplied the plans and a growing readership supplied the materials and muscle to build the Sports Sled, a beamy, stable, plank-on-frame utility boat. Our run-about ferried fishing gear, water skis, scuba tanks and up to six people for the meager sum of \$200, sans engine.

## Laser's Bright Promise

Death rays and antimissile lasers were scoffed at as unattainable a quarter century ago. But PM did chronicle laser achievements up till then, including complex cutting solutions and elementary eye surgery. The National Bureau of Standards was tapping the laser's potential as a measurement tool. And lasers employing gallium arsenide crystals were gaining ground at General Electric and IBM in the race for laser-based data transmission. **PM**





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Working with others.

In a national survey, more than 850 employers said these are what you must do to succeed in a career. They are also what you have to learn to succeed in the Army.

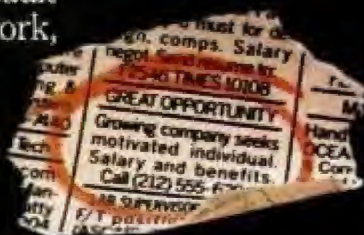
Which makes the Army a good place to prepare yourself for the working world.

And whether you're a member of an air assault team or a tank platoon, you'll be learning teamwork, responsibility, and self-discipline — the qualities employers want their people to have.

So when it's the first day on your new job, your boss won't have to show you the ropes.

Because you'll already know them.

To find out more about how the Army can help give you an edge on a career — and on life — call 1-800-USA-ARMY.



**ARMY.**  
**BE ALL YOU CAN BE.**



# TECH UPDATE

News Of Tomorrow's Technology Today

## Revamped, Scaled-Back LHX May Take To The Air In The Mid-90s



The Boeing Sikorsky LHX variant fires an air-to-air missile.

STRATFORD, CT—The U.S. Army's plans for a light attack, reconnaissance rotorcraft are back on the drawing boards following near extinction at the hands of budget cutters.

The resulting bird is far leaner than its 9000-pound predecessor, weighing in at 7500 pounds. It sports a simplified Mission Equipment Package (MEP) that will allow the aircraft to "acquire and fire" at opposing tanks and helicopters at safer, stand-off ranges.

The avionics package has helmet-mounted displays, digital terrain maps with a global positioning system (GPS) interface. Fiberoptic

waveguides provide signal transmission and processing.

The Boeing Sikorsky version of LHX, illustrated, features a fin-in-fan T-tail empannage, a chin-mounted 20mm gun turret, and retractable missile sponsons. The LHX prototype offered by the competing team of McDonnell Douglas/Bell Textron has the NOTAR (or no tail rotor) antitorque system.

In both models, composites and photonics become the real keys to LHX—as the Army's air cavalry flies into the next century.

Editor: Tim Cole  
Assistant Editor: Abe Danc  
Contributors: Mike Filon,  
Nick Nichols, Gregory T. Pope

## Highlights This Month

- **B-2 Rolls Out**—PM goes to Palmdale for the Stealth Bomber unveiling.
- **Fun Tech At A Theater Near You**—Motion simulators change amusement park thrills.
- **Energy Breakthroughs**—Salt dome storage facilities will help meet peak power demands.
- **Robots Get Smarter**—Tactile sensors mean end-effectors can stay in touch.
- **X-Raying The Shuttle**—Giant imaging machines peer inside solid rocket booster.
- **Fusion Research**—Lasers enter the race for unlimited power.
- **Behind Enemy Lines**—Modifying military aircraft for specialized warfare.



## Stealth Unwrapped

PALMDALE, CA—The B-2 Stealth Bomber was finally revealed to a limited gathering of press and public last November where PM was on hand for a ceremony which

ushered in a new era in strategic deterrence:

The B-2 incorporates numerous radar-evading features, such as advanced radar-absorbing composites,

The revolutionary shape of tomorrow's bomber/penetrator.

Just as significant, officials say, are the many manufacturing efficiencies introduced by the revolutionary B-2 project.

First flight is scheduled for

later this year, but many think the B-2's biggest hurdle will be with Congress when it comes to grips with the B-2's projected price tag—\$580 million a copy.

## New Rides To Nowhere

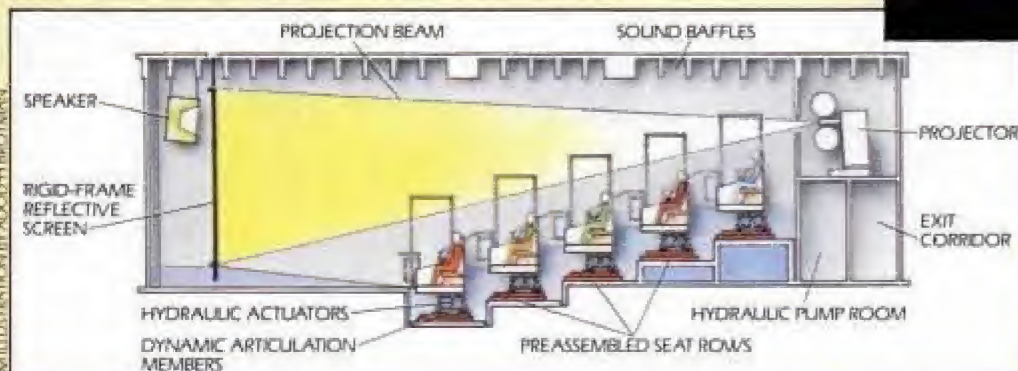
CULVER CITY, CA—Simulator-based attractions are fast becoming the new wave in theme park thrills.

With theater seats that yaw, pitch and roll in synch with on-screen visuals, the latest innovation comes from

a collaboration between ride maker Intamin, Inc. and Showscan Film Corp.

Intamin's Dynamic Motion Simulator is at the heart of the latest system—a 9-seat theater row that is supported by articulating swing arms and

Motion simulators are placed in five theater rows.



Underseat mechanics synch movements with film action.

hydraulic actuators. Micro-processors choreograph seat movements according to visual stimuli.

Riders get the same old chills and spills. Amusement park operators get reduced capital installation and lower insurance premiums.

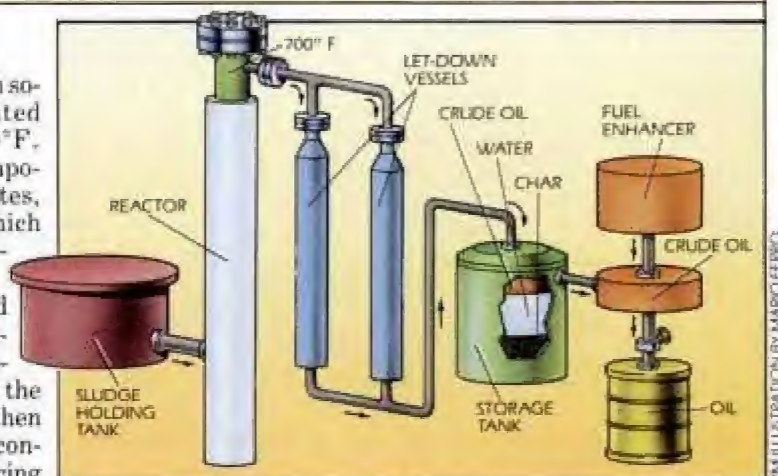
## Making Oil From Sewage

RICHLAND, WA—A continuous thermochemical liquefaction process pioneered at Battelle Pacific Northwest Laboratories, and a fuel enhancement technique designed by the Innotech Corp., could one day generate sufficient energy to power sewage disposal processes.

The system, could result in significant saleable energy surpluses and an 80 percent reduction in sewage volume.

In today's prototype form, the process starts when sew-

age sludge is treated with sodium carbonate and heated under pressure to 700°F. This digests sewage components such as carbohydrates, cellulose and lignin, which recombine into hydrocarbons. The hydrocarbons are then enhanced through Innotech's emulsifying process. The combustible diesel fuel oil at the end of the treatment can then be burned to power the conversion machinery, reducing pressure on sewage landfills.



Oil extraction method results in energy surplus, sewage reduction.



## Snooper Sub

RIVIERA BEACH, FL—Submersible technology—long used in underwater construction work and archeology—now extends to coastal surveillance with the Perry Offshore, Inc. surface video scanner.

The semisubmersible remotely operated vehicle maneuvers up to 10 nautical miles from base on a 24-volt battery pack. A 2-hp motor powers the device at a maximum speed of 6 knots for up to 2 hours.

Heart of the surveillance tool is a low-light level video

camera incorporating a 17.5 to 108mm zoom lens installed in the sub's periscope-like sail. With a total weight of 250 pounds and an overall length of 10 ft., Perry says its device is easy to deploy and recover. It can be used in most weather conditions and in light levels ranging from high noon to evening starlight.

Potential customers: security agencies, drug enforcement personnel or scientific research groups.

**Perry's diminutive semisub spots coastal capers with low-light video camera.**



PM ILLUSTRATION BY DON MANNES

## New Ways To Meet Off-Peak Power Demands

M'INTOSH, AL—Compressed air storage facilities flushed out of underground salt domes and immense battery packs are being enlisted by utilities to furnish power during peak periods.

In McIntosh, Alabama, the Alabama Electric Coopera-

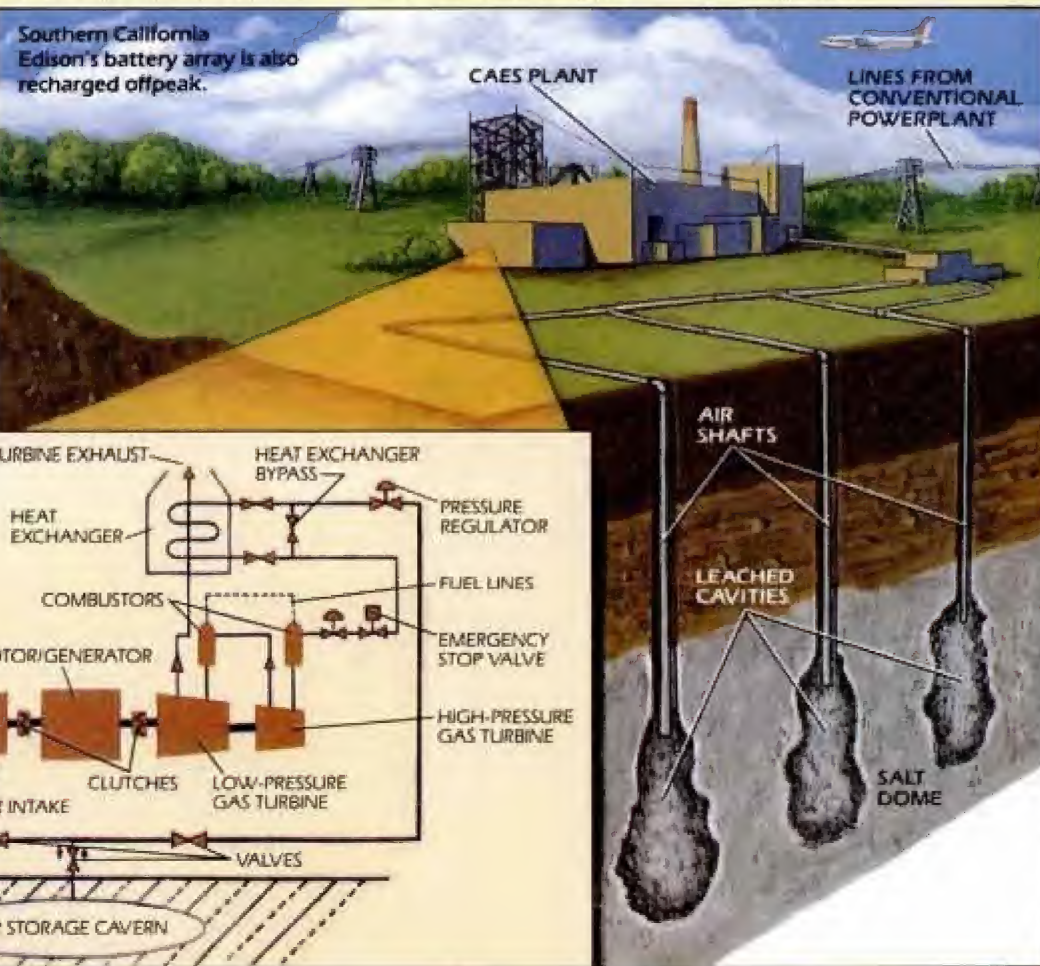
tive is pioneering the salt dome concept in the U.S. with the Compressed Air Energy Storage (CAES) plant. Compressors powered by surplus electricity fill the 19-million-cu.-ft. dome off-peak.

During periods of increased demand, the pres-

surized air is released, heated and expanded, spinning a turbine power generator. Using compressed air out of storage instead of producing compressed air with an attached compressor train makes the gas turbine 70 percent more cost efficient.

The world's largest battery storage facility is pulling similar duty at Southern California Edison Co. The utility charges the system at night when demands are low.

Utility officials say the systems provide better power management.



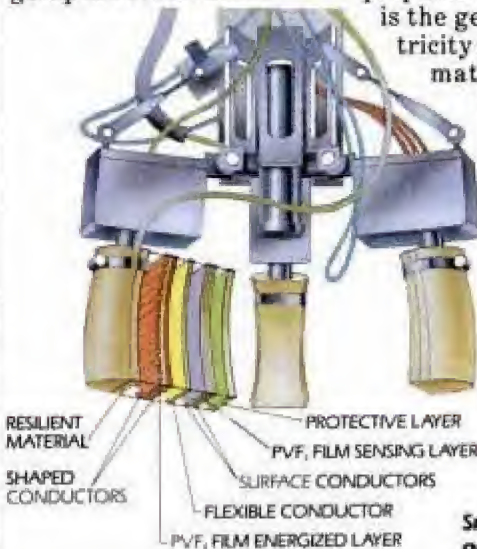
The CAES plant generators, turned by system's compressors, produce 110 megawatts of power. Air comes from caverns.

PM ILLUSTRATION BY DAVID FISHERMAN



## Tactile Robo-Sensors

COLUMBUS, OH—Researchers at Batelle Columbus Laboratories are closer to duplicating the human fingertip on robotic "hands."



The end effectors are being equipped with polyvinylidene fluoride polymer layers that exhibit piezoelectric properties. Piezoelectricity is the generation of electricity in nonconductive materials through mechanical stress. After the material is encased in protective layers and energized, it becomes sensitive to mechanical or electrical stimulation—crucial to high-tech chores.

Smart robots get smarter.



Linatron produces 1500 times the voltage of dental X-ray machine.

## X-Raying Shuttle Boosters

PALO ALTO, CA—An X-ray machine producing up to 15-million electron volts is peering inside NASA's Space Shuttle solid rocket boosters to spot defects.

The Varian Linatron 6000 produces X-rays that penetrate the 126-ft. x 12-ft. SRB segments' steel casing, insulation and propellant. Im-

ages are captured on special industrial X-ray film inside the boosters' solid core. A computerized automatic film-handling system delivers the images for analysis.

The advanced radiography system assists SRB maker Morton Thiokol in ensuring quality control following the Challenger disaster.

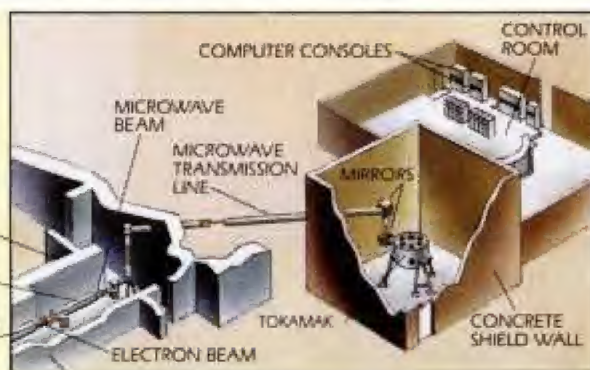
## Laser-Controlled Fusion

NEW YORK, NY—Developing an inexhaustible energy supply through the controlled fusion of heavy isotopes of hydrogen has been a national priority for nearly 30 years. Recent efforts are focusing on the use of lasers to heat hydrogen plasma, critical to the fusion process, over traditional

methods involving neutral particle beam injection, or electron-cyclotron/ion-cyclotron techniques.

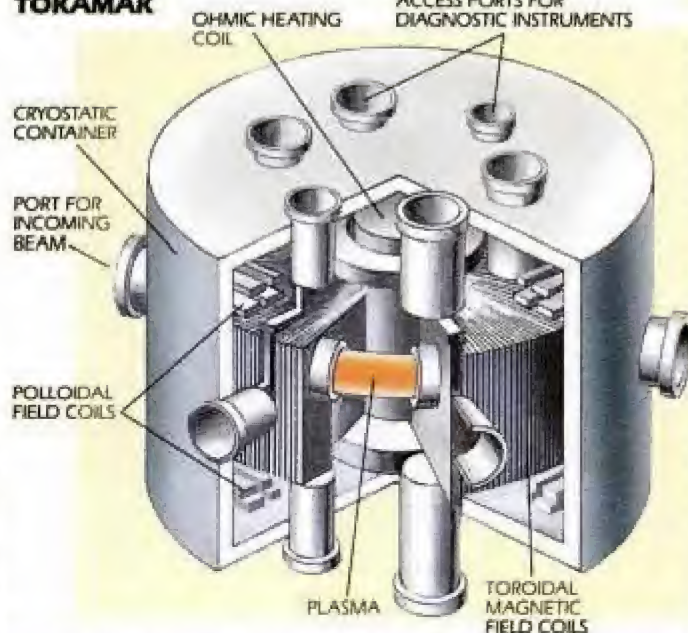
Scientists at Lawrence Livermore National Laboratory are constructing a free-electron laser (FEL) coupled to a magnetic plasma confinement device, or tokamak. High-fre-

CONCRETE SHIELD WALL  
FREE ELECTRON LASER WIGGLER  
ELECTRON-BEAM ACCELERATOR



EXPERIMENTAL TEST ACCELERATOR

### TOKAMAK



Livermore's magnetically controlled plasma flows inside toroidal tokamak following ignition by free-electron laser.

quency FELs in visible and infrared wavelengths have excellent "tunability," which yields greater plasma heat control. Earlier heating techniques encountered difficulties in plasma penetration.

At the University of Rochester, scientists are using a neodymium-glass laser split through a complex optics array to vaporize a target pellet of deuterium and tritium, hydrogen's heavy isotopes. The device has produced the highest thermonuclear yield efficiency of any laser fusion facility to date. As an intriguing scientific by-product, it simulates temperatures and densities associated with stars, giving researchers a chance to study high-ionized atoms and

other astrophysical phenomena. Despite the advancements, researchers consider widespread use of fusion energy a distant dream.

A deuterium tritium target is vaporized inside U of R's laser-controlled fusion device.



UNIVERSITY OF ROCHESTER PHOTO

(More Tech Update on page 25)



**AFTER 50 YEARS OF  
BRINGING YOU THE POWER**

**MERCURY**



# WE PRESENT



## INTRODUCING ASTRO™ FISHING RIGS FROM MERCURY

For generations, one word has become synonymous with proven performance on the water. Mercury.

And now, Mercury brings its legendary reputation to a new and distinctive line of boats.

Introducing Astro fishing rigs.

Exciting. Dynamic. And rigged for peak performance. Exactly what you'd expect from the Mercury Powerboat division of Brunswick Corporation, the world's largest marine manufacturer.

You'll like everything about Astro fishing boats. Because everything that goes into an Astro fishing boat is entirely designed and built with only one thing in mind. You.



*Built-in fishing rod savers*

Your complete satisfaction is all that matters. To us. And to your Astro boat dealer.

We know, by talking to boaters like yourself, the one thing you want most is trouble-free fishing. And that's what you can expect from Astro fishing rigs. No matter which model you run with.

**WITH 46 DIFFERENT MODELS,  
THERE'S AN ASTRO TO PUT  
YOU IN ALL YOUR GLORY.**

You're sure to find an Astro polyglass or aluminum boat



*Aerated tournament live wells*

with just the right equipment, accessories, power and price for your way of thinking. And fishing. And when you compare an

Astro fishing rig to the same type package from someone else, you'll discover no one comes close to giving you more standard features for your money than Astro.

Every boat, motor and trailer is designed as an integrated rig. And, unlike other boat packages, each Astro is matched to a specific out-board for peak performance. What's more, every model has been tested to assure the maximum in reliability.

And because we build them so well, we can



*Sport steering wheel*



*Full instrumentation*



*Lowrance fish finder*



# THE GLORY.



\*See back page for financing information.



Heavy-duty batteries

offer a tough, Stern-to-Stern™ limited warranty to back up what we promise.

So you can buy with confidence.

As for the price, you'll find Astro fishing rigs starting from \$1,899\* complete. There's no inflated rigging or dealer prep charges. You can't find a fishing rig that gives you more for your money. Or a more honest value. But you'll figure that out as soon as you put an Astro fishing rig up against the same type of package from any other manufacturer.



Quicksilver™ "Laser II"™ stainless steel propeller

boats at just any dealer. Because an Astro isn't just *any* fishing boat.

Astro dealers have to live up to some pretty tough standards. Why? Because we know you want to deal with people who are knowledgeable and professional. People who are in business for the long haul.

People who will do everything possible to make sure you are completely satisfied. People who offer not only boats, but expert service, a complete inventory of parts and accessories, and advice worth listening to.

People who want to make your boating trouble free.

And your Astro dealer can offer you the convenience



Quality trailer wheels

of MMAC financing. So it will be easy for you to take quick delivery on your new Astro.

## CHECK OUT AN ASTRO FOR YOURSELF AT YOUR NEAREST DEALER

For 50 years, Mercury has been bringing you the power. Now your Astro dealer brings you the glory. The remarkable Astro Fishing Boat line.

Call 1-800-BOATS-90 for free information and the location of your nearest Astro dealer.

Get the feel of an Astro for yourself. It'll put you in your glory.

IT STANDS TO REASON, ONLY THE BEST BOATS CAN COME FROM THE BEST DEALERS.

You won't find Astro fishing

**ASTRO** T.M.



An aerial photograph of two Astro Quickfire polyglass fishing rigs on the water. The larger rig in the upper left is red and has two people on board. The smaller rig in the lower right is dark blue and has three people on board. Both boats are moving quickly, leaving white wakes behind them. The water is dark and choppy, with sunlight reflecting off the surface.

## **ASTRO QUICKFIRE POLYGLASS RIGS. DESIGNED TO LEAVE EVERYONE ELSE IN YOUR WAKE.**

The Astro Quickfire polyglass line includes 23 decked out rigs that other boat manufacturers find hard to match. From stern to stern, you'll find nobody gives you a more honest value than Astro. With standard features that are a lot more than just "bells and whistles".

But that's only half the story.

Astro Quickfire polyglass rigs include something else other boat manufacturers are hard-pressed to match. And that's the Astro dealer network. Astro dealers are chosen from the best in the business. And they're committed to giving you the back-up support, accessories, parts and service to keep your Astro on the water instead of stuck on the trailer.

See the back page for complete specifications on the entire Astro Quickfire polyglass line of top-performance fishing rigs. For free information and the location of your nearest Astro dealer, call **1-800-BOATS-90**.





ASTRO "QUICKFIRE 19 FD"  
FLIPPIN' DECK BASS RIG

**\$15,499 or as low as \$185.06 per month.\***

☐ High-level front casting deck to accommodate flippin' ☐ Tournament-ready dual recirculating livewell system with timers ☐ Twin, 22-gallon fuel tanks ☐ Deluxe dash instrumentation panel with built-in Lowrance 1240 flasher, Quicksilver™ tachometer, speedometer, volt meter, water temperature and fuel gauge ☐ Mercury Thruster® 24/12 foot control trolling motor with Whisper Drive™ system and Machete™ prop ☐ Performance matched "Laser II™" stainless steel propeller, standard ☐ Two deep-cycle trolling motor batteries and cranking battery with trays ☐ Big performance from the legendary Mercury XR4, 150 hp with power trim and tilt ☐ Custom-matched deluxe drive-on trailer



ASTRO "QUICKFIRE 18 SC"  
SINGLE CONSOLE BASS RIG

**\$13,999 or as low as \$167.15 per month.\***

☐ Our "Most Popular" rig ☐ Spacious bow casting deck with built-in aerated livewell and tackle tray ☐ Extra large rear casting deck with built-in tournament recirculating contoured livewell and twin insulated storage compartments ☐ Deluxe dash instrumentation panel with built-in Lowrance 1240 flasher, Quicksilver™ tachometer, speedometer, volt meter, water temperature and fuel gauge ☐ Mercury Thruster® 12 volt foot control trolling motor with Whisper Drive™ system and Machete™ prop ☐ "Pro style" bow trolling motor panel with 6 gauge wire ☐ Performance matched "Laser II™" stainless steel propeller, standard ☐ Two deep-cycle trolling motor batteries and cranking battery with trays ☐ Top performance Mercury XR4, 150 hp outboard with power trim and tilt ☐ Custom-matched deluxe drive-on trailer



ASTRO "QUICKFIRE 18 FS"  
FISH & SKI RIG

**\$13,999 or as low as \$167.15 per month.\***

☐ Walk-thru "sport windshield" with Clear Vision convertible top, boot, and curtain ☐ Front and rear aerated recirculating contoured livewells ☐ Deluxe dash instrumentation panel with built-in Lowrance 1240 flasher, Quicksilver™ tachometer, speedometer, volt meter, water temperature and fuel gauge ☐ Mercury Thruster® 24/12 foot control trolling motor with Whisper Drive™ system and Machete™ prop ☐ Performance matched "Laser II™" stainless steel propeller, standard ☐ Two deep-cycle trolling motor batteries and cranking battery with trays ☐ Legendary Mercury 150 hp outboard with power trim and tilt ☐ Custom-matched deluxe drive-on trailer



ASTRO "QUICKFIRE 16 FS"  
FISH & SKI RIG

**\$10,999 or as low as \$160.03 per month.\***

☐ Walk-thru "sport windshield" with Clear Vision convertible top, boot and curtain ☐ Front and rear aerated recirculating contoured livewells ☐ Deluxe dash instrumentation panel with built-in Lowrance 1240 flasher, Quicksilver™ tachometer, speedometer, volt meter, water temperature and fuel gauge ☐ Mercury Thruster® 12 volt foot control trolling motor with Whisper Drive™ system and Machete™ prop ☐ Performance matched "Laser II™" stainless steel propeller, standard ☐ Deep-cycle trolling motor battery and cranking battery with trays ☐ Smooth-running Mercury 90 hp outboard with power trim and tilt ☐ Custom-matched deluxe drive-on trailer

Call 1-800-BOATS-90 for free information and the Astro dealer nearest you. \*See back page for financing information.



# ASTRO ALUMINUM FISHING RIGS. THERE'S A LOT MORE TO THESE BOATS THAN SKIMS THE SURFACE.

When it comes to a complete line of fully-rigged aluminum fishing boats, you'll have to look long and hard to match Astro. With 23 different aluminum Astros to choose from, you're sure to find the rig that's decked out for your kind of fishing. From V hulls for taming big waves to flat bottoms for working your favorite lake. Once you compare an Astro aluminum rig to the same type package from another boat manufacturer, you'll find there's no comparison. Or better value.



And that's true when it comes to your Astro dealer as well.

It's just hard to find a more knowledgeable, professional dealer around. You'll get help and advice you can really use. Plus, there's all the support, service, parts and accessories you'll need to keep you on the water.

See the back page for complete specifications on the full Astro aluminum line of fishing rigs. For free information and the location of your nearest Astro dealer, call 1-800-BOATS-90.







ASTRO "LAKESPORT 14" FLAT BOTTOM RIG

**\$2,599 or as low as \$55.77 per month.\***

- ☐ Classic flat bottom aluminum design ☐ Reliable Mercury 15 hp outboard ☐ Custom-matched drive-on trailer



ASTRO "BASSPORT 16"  
MODIFIED V BASS RIG

**\$6,799 or as low as \$98.92 per month.\***

- ☐ Smooth entry modified V-hull design ☐ Four marine grade vinyl covered fishing seats ☐ Rear aerated livewell ☐ Deluxe dash instrumentation panel complete with Quicksilver™ tachometer, speedometer, volt and water temperature gauge ☐ Lowrance X4 LCR on swivel base ☐ 12V Mercury Thruster® foot control trolling motor ☐ Marine carpet over all-aluminum floor and deck panels (no wood) ☐ Double-anchored "spring-loaded" pedestal bases ☐ Performance-matched Quicksilver™ stainless steel propeller, standard ☐ Deep-cycle trolling motor battery and cranking battery with trays ☐ Smooth running Mercury 40 hp outboard with power trim and tilt ☐ Custom-matched deluxe drive-on trailer



ASTRO "LAKESPORT 16 V DLX"  
VEE HULL RIG

**\$4,999 or as low as \$107.27 per month.\***

- ☐ Wave Tamer™ aluminum V-bow design ☐ Two marine grade vinyl covered pedestal fishing seats ☐ Aerated livewell ☐ Quiet, powerful Mercury Thruster® trolling motor ☐ Lowrance X4 LCR on swivel base ☐ Marine carpet over all-aluminum floor panels (no wood) ☐ Double-anchored pedestal bases ☐ Deep-cycle trolling motor battery and cranking battery with trays ☐ Dependable Mercury 25 hp outboard with electric start ☐ Custom-matched deluxe drive-on trailer



ASTRO "QUICKFIRE 18 GT"  
V HULL PERFORMANCE BASS RIG

**\$11,999 or as low as \$174.58 per month.\***

- ☐ New design concept in lightweight, high-performance aluminum hulls ☐ Dual aerated livewells with timers ☐ Built-in 22-gallon fuel system ☐ All aluminum floors and decks (no wood) ☐ Deluxe dash instrumentation panel complete with Quicksilver™ tachometer, speedometer, volt and water temperature gauges ☐ Lowrance X4 LCR on swivel base ☐ Mercury Thruster® 24/12 foot control trolling motor with Whisper Drive™ system and Machete™ prop ☐ Double-anchored "spring-loaded" pedestal bases ☐ Performance-matched Quicksilver™ stainless steel propeller, standard ☐ Two deep-cycle trolling motor batteries and cranking battery with trays ☐ Top-performance Mercury 115 hp outboard with power trim and tilt ☐ Custom-matched deluxe drive-on trailer

Call 1-800-BOATS-90 for free information and the Astro dealer nearest you. \*See back page for financing information.



# THERE'S AN ASTRO FISHING RIG TO MEET YOUR SPECIFICATIONS

## Astro Aluminum Fishing Rigs

Mercury Outboard	Power Trim	Estimated Monthly Payment/Term (See Note 1)	Length	Beam	Mercury Thruster Trolling Motor	Quicksilver Propeller <sup>†</sup>	Full Quicksilver Instrumentation	Fish Locator		Marine Batteries	Fuel Capacity	Custom Drive-on Trailer	As Low As (See Note 2)
								Lowrance X4	Lowrance 1240 In Dash				

### FLAT-BOTTOM RIGS Lakesport fishing rigs for serious fishermen on a budget.

Lakesport 14	5 hp	\$40.75/48 mo	14'	54"		AL					6 gal	*	\$ 1,899
Lakesport 14	15 hp	\$5.77/48 mo	14'	54"		AL					6 gal	*	2,399
Lakesport 15	9.9 hp	\$7.92/48 mo	15'	62"		AL					6 gal	*	2,699
Lakesport 15	20 hp	\$4.35/48 mo	15'	62"		AL					6 gal	*	2,999

### VEE HULL RIGS Tough, versatile, V-bottom rigs.

Lakesport 14V	9.9 hp	\$ 62.21/48 mo	14'	59"		AL					6 gal	*	\$ 2,899
Lakesport 14V DLX	15 hp	\$9.37/48 mo	14'	59"	12V	AL		*		1	6 gal	*	3,699
Lakesport 14V DLX	25 hp	\$5.81/48 mo	14'	59"	12V	AL		*		1	6 gal	*	3,999
Lakesport 16V DLX	20 hp	\$10.83/48 mo	15'11"	67"	12V	AL		*		1	6 gal	*	4,699
Lakesport 16V DLX	25 hp	\$10.27/48 mo	15'11"	67"	12V	AL		*		2	6 gal	*	4,999
Lakesport 16V Special	25 hp	\$12.29/48 mo	15'11"	67"	12V	AL	*	*		2	6 gal	*	5,699

### DEEP V HULL WALLEYE RIGS Designed for walleye and big water lakes.

Lakesport 16V PRO	25 hp	\$128.73/84 mo	16'2"	76"	12V	AL	*	*		2	6 gal	*	\$ 5,999
Lakesport 16V PRO	50 hp	\$116.38/84 mo	16'2"	76"	12V	S.S.	*	*		2	6 gal	*	7,999
Lakesport 18V PRO	80 hp	\$160.03/84 mo	18'2"	84"	24/12V	S.S.	*	*		3	22 gal	*	10,999
Lakesport 18V PRO SPECIAL	80 hp	\$171.67/84 mo	18'2"	84"	24/12V	S.S.	*	*		3	22 gal	*	11,799

### MODIFIED V CRAPPIE RIG A special Lakesport for crappie fishermen who prefer aluminum.

Lakesport 16 DLX	25 hp	\$102.98/48 mo	16'	69"	12V	AL		*		2	6 gal	*	\$ 4,799
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### MODIFIED V BASS RIGS Classic, pro-equipped bass boats.

Bassport 16	25 hp	\$115.85/48 mo	15'7"	62"	12V	AL	*	*		2	6 gal	*	\$ 5,399
Bassport 16	40 hp	\$98.92/84 mo	15'7"	62"	12V	S.S.	*	*		2	6 gal	*	6,799
Bassport 16 PRO	35 hp	\$91.65/84 mo	16'	69"	12V	AL	*	*		2	6 gal	*	6,299
Bassport 16 PRO	50 hp	\$112.01/84 mo	16'	69"	12V	S.S.	*	*		2	6 gal	*	7,699

### V HULL PERFORMANCE BASS RIGS Light, fast and loaded for lunkers.

Quickfire 16 GT	40 hp	\$126.56/84 mo	16'	73.5"	12V	S.S.	*	*		2	12 gal	*	\$ 8,699
Quickfire 16 GT	70 hp	\$145.48/84 mo	16'	73.5"	12V	S.S.	*	*		2	12 gal	*	9,999
Quickfire 18 GT	80 hp	\$160.03/84 mo	17'10"	82"	24/12V	S.S.	*	*		3	20 gal	*	10,999
Quickfire 18 GT	115 hp	\$174.58/84 mo	17'10"	82"	24/12V	S.S.	*	*		3	20 gal	*	11,999

## Astro Quickfire Polyglass Fishing Rigs

### QUICKFIRE CRAPPIE STYLE RIGS Versatile fishing rigs.

15CR	35 hp	\$109.01/84 mo	15'5"	76"	12V	AL	*	*		2	12 gal	*	\$ 7,299
16CR	60 hp	\$120.74/84 mo	15'5"	76"	12V	AL	*	*		2	12 gal	*	8,299
16CR	80 hp	\$145.48/84 mo	16'4"	80"	12V	S.S.	*	*		2	12 gal	*	9,999

### QUICKFIRE SINGLE CONSOLE BASS RIGS True classics, our best sellers.

155C	60 hp	\$130.93/ 84 mo	15'5"	76"	12V	S.S.	*	*		2	12 gal	*	\$ 8,999
165C	70 hp	\$139.66/ 84 mo	16'4"	80"	12V	S.S.	*	*		2	17 gal	*	9,599
175C	90 hp	\$160.03/ 84 mo	16'10"	82"	24/12V	S.S.	*	*		3	24 gal	*	10,999
175C	115 hp	\$167.30/ 84 mo	16'10"	82"	24/12V	S.S.	*	*		3	24 gal	*	11,499
185C	115 hp	\$151.63/120 mo	18"	86"	24/12V	S.S.	*	*		3	24 gal	*	12,699
185C	150 XR4	\$167.15/120 mo	18"	86"	24/12V	S.S.	*	*		3	24 gal	*	13,999
195C	150 XR4	\$179.09/120 mo	19'9"	88"	24/12V	S.S.	*	*		3	36 gal	*	14,999
195C	200 hp	\$187.45/120 mo	19'9"	88"	24/12V	S.S.	*	*		3	36 gal	*	15,699

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18DC	150 XR4	\$171.93/120 mo	18"	86"	24/12V	S.S.	*	*		3	24 gal	*	14,399
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17FS	115 hp	\$171.67/ 84 mo	16'10"	82"	24/12V	S.S.	*	*		3	24 gal	*	11,799
18FS	115 hp	\$155.21/120 mo	18"	86"	24/12V	S.S.	*	*		3	24 gal	*	12,999
18FS	150 hp	\$167.15/120 mo	18"	86"	24/12V	S.S.	*	*		3	24 gal	*	13,999
19FS	150 hp	\$179.09/120 mo	19'9"	88"	24/12V	S.S.	*	*		3	36 gal	*	14,999

NOTE 1: Payments listed are for qualified buyers at participating MMAC financing Astro dealers and are based on 12.99% APR, 20% down (cash or trade) plus applicable taxes, licenses and fees. Specific monthly terms are noted. Ask your Astro dealer for complete details.



NOTE 2: Suggested Retail Prices listed are for customers East of Rocky Mountains. Because of additional freight expense, prices are slightly higher west of Rockies.

† AL = aluminum S.S. = stainless steel

We are constantly striving to improve our boats and therefore must reserve the right to change specifications and prices without notice. Photographs may include optional equipment. Astro fishing rigs are products of Mercury Powerboat, A Brunswick Co. © Brunswick Corporation 1989



## Special Report: Covert Aircraft

NEW YORK, NY—Projecting force with unprecedented speed, stealth and firepower, a new generation of military aircraft is entering service for specialized missions. Based on existing airframes, the planes incorporate advanced electronics and mission-specific hardware to find their way to distant targets through enemy fire and adverse weather.

To insert and extract small ground detach-

.50-caliber machine guns, and optional air-to-air missiles.

The Air Force will transport and resupply special operations forces with the MC-



MC-130H (above) and electronic warfare operator's (EWO) post (below), with data-entry keyboards.



ments behind enemy lines, the Army's special operations contingent will use the MH-60K Blackhawk, a variant of its UH-60A utility helicopter. Scheduled to begin service in late 1992, it will be equipped with terrain avoidance/terrain following radar (TA/TF) and a forward-looking infrared sensor (FLIR) for ground-hugging flight in any weather. With two external 230-gallon fuel tanks, the MH-60K can carry 12 troops 927 nautical miles before refueling, which can be accomplished in flight. Armament will consist of two

130H Combat Talon II, based on the venerable C-130H transport. Radically upgraded avionics, including TA/TF, FLIR, and top-secret electronic warfare gear, help the MH-130H evade detection, and gather intelligence. Readouts come through high-resolution multifunction CRT displays provided for pilot, copilot, navigator and electronic warfare operator (EWO). In the cargo bay, 68 combat-ready troops can be transported. And a high-speed, low-level aerial delivery system fitted to the rear

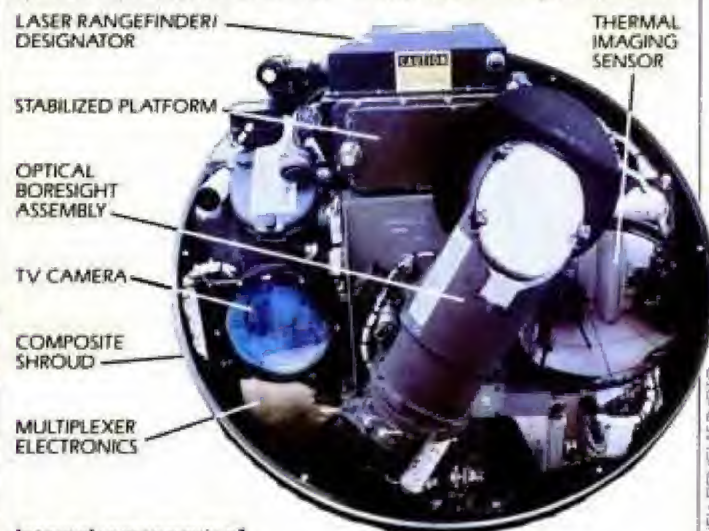


MH-60K Blackhawk, with external tanks and refueling probe.

loading ramp permits air-drops at over 150 mph. Explosion-suppressive external fuel tanks, and an in-flight refueling probe extend the C-130's range.

Not officially intended for special operations use, but

very low-friction spherical ball bearing atop a nonrotating standpipe passing through the rotor hub, the sight is gyro-stabilized and pointed with



Internal components of MMS for OH-58D Scout.

likely to play a role stalking targets in hostile territory, the Armed OH-58D Scout helicopter relies on a periscope-like Mast Mounted Sight (MMS). The device enables operators to take a bead on ground targets while it is almost completely concealed by terrain. Mounted with a

magnetic torquers. Data from the MMS's sensors can be relayed to attack aircraft, or the laser rangefinder/designator can illuminate targets to guide Copperhead artillery rounds. The Armed OH-58D can itself carry Hellfire anti-tank missiles, a .50-caliber machine gun or Stinger air-to-air missiles.



OH-58D Scout with MMS above rotor.



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*1st HDRA  
Fireworks 250 Class 4*



*1st (again)  
SCORE Great Mojave  
250 Class 7*



*1st HDRA Gold Coast  
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HDRA/SCORE  
Class 75*



*1st (again)  
HDRA Fireworks 250  
Class 4*



*1st SCORE Baja  
Internacional Class 7*



*1st (by over an hour)  
SCORE Baja  
Internacional Class 75*



*1st MTEC Rosebowl  
Class Racetruck*



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a 3rd) HDRA Nissan  
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*1st SCORE Baja  
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1st (again) SCORE Great Mojave 250 Class 7S



1st HDRA Nissan Mint 400 Class 7S



1st (by over an hour) HDRA Barstow 250 Class 7



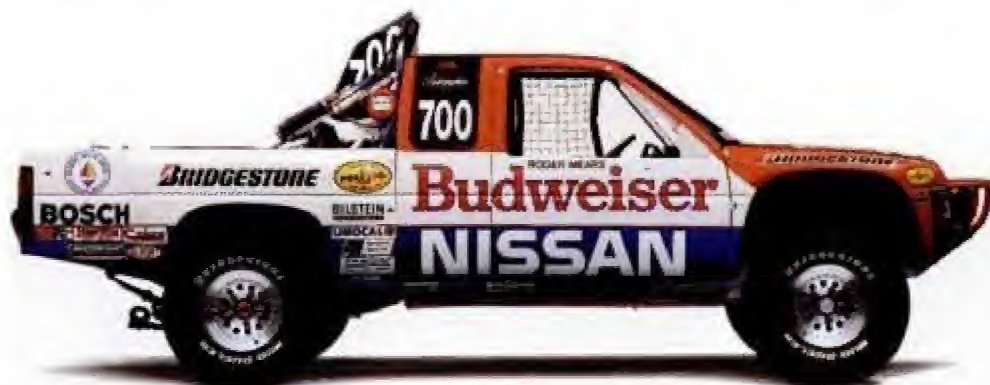
1st SCCA Coors Challenge Class Racetruck



Champion HDRA/SCORE Mini Metal Series



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# OUTDOORS

BY JOE SKORUPA

## Playing In The Bonefish League



Ted Williams (center) stalks cagey bonefish in the Keys with Jim Bashline (left) and guide Frank Garisto.

**A**FTER a recent fishing trip in Florida, a scene from the short-lived "Slap Maxwell" TV series comes to mind. Actor Dabney Coleman, who plays the title character, a beleaguered sportswriter, climbs onto a window ledge, turns his face skyward, and starts talking to the Big Guy. In Slap's case, the Big Guy is Ted Williams, Hall of Fame baseball player.

Slap, who's about to be fired, asks for guidance and winds up by admitting he knows there's little chance his plea will be heard, because, "Ted, I know you're probably busy right now, down South somewhere in the saltwater flats, hooking into some hard-fighting bonefish."

In case you haven't kept up with Ted Williams's post-baseball career, Slap was probably right. The one and only time I met Ted was in the Florida Keys, and he was bonefishing. But Slap is wrong in thinking Ted

spends *all* his time bonefishing. For large parts of the year he fishes for salmon and tarpon. He's also caught a few trout, blue marlin, white marlin, tuna, bluefish and walleye in his time.

The essential point—both Slap's and mine—is that Ted Williams is a devoted fisherman. And, as you might expect from baseball's last .400 hitter, he's pretty good at it. I witnessed Ted fishing for bones with a fly rod, making casts of at least 80 ft., and dropping flies on little more than a dime.

### Big leaguers

Accompanying Ted on the trip to Key Biscayne was another man, Jim Bashline, who handles a fly rod like Zorro handles a blade. Jim's a noted outdoorsman and author of such books as *Atlantic Salmon Fishing* and *Night Fishing For Trout*.

He's also a frequent contributor to *POPULAR MECHANICS* and I went to the Keys to talk to him about fu-

ture projects. Ted is also working on a future PM piece (look for his story in the special "American Adventure" section in our May issue), so we decided to make it a happy threesome.

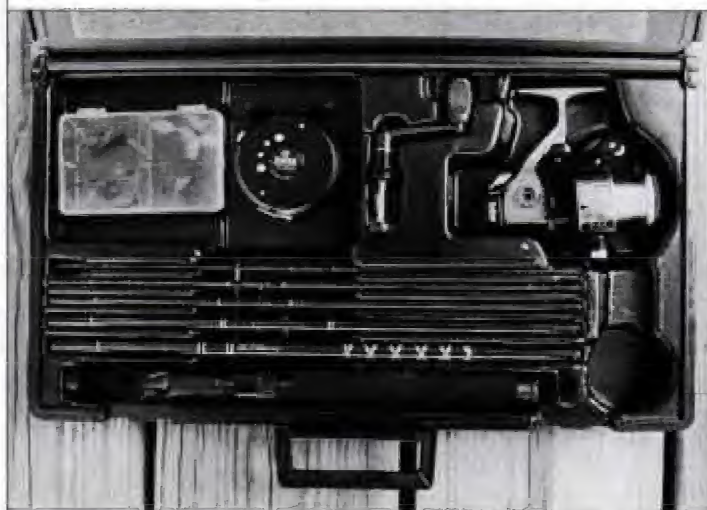
However, after seeing these guys hit a speck with a fly rod at 30 yards, I began to feel I might be playing in the wrong league. So, at first light, when the two guides

Baseball's last .400 hitter, Ted Williams, now swings a mean fly rod.

arrived at the Biscayne Bay Yacht Club, I suggested that Ted and Jim go with one guide, in his 3-man boat, while I went with the other.

### Flats fishing

My guide for the day was Floyd Landon, aboard the *Mikitu*. Floyd, who's seen the better part of seven decades, first came across *POPULAR MECHANICS* in 1934 when he spied plans to build a race car. He and a teenage pal used junk parts from a Ford Model T to build a car based on the plans, and placed fourth in the first race they entered. A man at the race offered the boys \$850 for the car in the heart of the Depression and, without hesitation, they sold it for "more



Daiwa's Fisherman's Travel Pack is as big as an attaché case.



money than a teenager has ever seen."

Today, Floyd is still a man who recognizes a worthwhile design. His boat, a 10-year-old Maverick, is an ideal flats fishing machine. If you've never seen a Florida flats boat, they're a marvel of sport-specific design.

Since bones feed in shallow water, flats boats have a minimum of draft, about 10 in. They mount the outboards high on the transom and run confidently in 18 in. of water. The *Mikitu* was equipped with a 90-hp Evinrude outboard, so we covered the territory south of Key Biscayne at about 40 mph.

Bones are line-of-sight fish—you don't cast unless you see one—so we hunted for them from Stiltsville to Soldier's Key, from the Ragged Keys to Sands Key, and all the way south to Elliott Key, which is about 20 miles from where we started. The flats boat handled this hard running well. Its sturdy, mod-V hull knifed through the chop as well as a seaworthy center-console boat.

Also like center consoles, flats boats have obstruction-free deck areas with plenty of stowage space, room for electronics on, or in, the side console, and a raised casting platform in the bow, where most of the fishing is done.

There are important differences as well. For one thing, the guide sits on the wide wraparound side deck while the two passengers (the boats are designed for a maximum 3-man load) sit on mounted seats in the stern.

But the most unique difference is the polling platform, a 2-ft.-sq. pedestal that rises above the outboard. This is where the guide stands and, like a Venetian gondolier, poles the boat quietly through the shallows while keeping an eye peeled for silvery green bones.

### Finicky fish

While my companions were using fly rods to catch the cagey bones, I came equipped with Daiwa's Executive Fisherman's Travel Pack (\$99), which stores a collapsible 6½-ft. spinning/fly rod, a TG1300 Long Cast spinning reel, a 730 fly reel, and a mini tackle box. I brought this handy setup to help me get through the gauntlet at the airport. About the size of a small attaché case, the lightweight pack is an ideal carry-on.

Not being an experienced fly fisherman—something I intend to correct in the near future—I used the spinning gear to make a few practice casts, while Floyd filled me in on my elusive quarry. Bones have superb eyesight and spook easily. Something as simple as the sun glinting off reflective sunglasses can make them run. A trolling motor, regardless of its near-silent sound, is as noisy as a freight train to bones.

And when you make your cast, be sure it drops 2 to 3 ft. directly in front of the fish. If it lands behind, he'll never

see it. If too far ahead, he may veer off. If too close, he'll run. In bonefishing, presentation is everything. Hit your spot with a quick overhand flip of the wrist, let it drift to the bottom and wait.

Of course, you do a lot of waiting anyway. We didn't see a bone all morning. Just toothy barracuda and mullet. After lunch we started working spots along the route back to Key Biscayne. Just before Stiltsville (literally, a place where houses are built on pilings) we stopped on a flat and I saw my first bone. A few minutes later I saw my second and third bones. They didn't see my casts, however, or didn't like what they saw.

### In the clubhouse

Back at the Biscayne Yacht Club, I rendezvoused with Ted, Jim and their guide, Frank Garisto. "How'd you do?" I asked. "We caught and released four," Jim said. "Ted had three and I had one." Well, I thought to myself, these guys are in the big leagues. I'd be surprised if they didn't catch anything.

The next morning as we were heading out again, I said to Frank, "So, you spotted a few more bones than we did yesterday." Frank shrugged his shoulders and said, "Not really." This surprised me. "But Ted and Jim caught four good-size bones," I protested. "They told you that?" said Frank with a crooked smile. Then he shook his head back and forth, and I realized that I'd just learned another lesson from the masters. Never believe what a fisherman says unless you've seen it with your own eyes.

Fishing with Ted and Jim, who have a combined fishing background of 90 years, was quite a thrill. When you sit down with these guys, over drinks or a meal, it's like a grad-school course on pro-level fishing.

This was especially true of Ted, who's an intense man to begin with. Only the best will do for Ted, whether it's in baseball, fishing, hunting, flying, boating, photography or any endeavor. He's a man who can't abide a fool and forces the level of conversation to a lofty standard, a standard that fits a man who ranks second to Babe Ruth in slugging percentage and won baseball's Triple Crown (homers, average, RBI) twice.

Still, nobody caught a bonefish. The reason? Some people say increasing popularity and fishing pressure have made them scarce in the Upper Keys. Luck also had something to do with it.

Bonefish are fussy feeders, unpredictable and wily adversaries. Floyd, my guide, admitted it took him six months before he caught his first bone after moving to Florida. But a good fishing trip isn't necessarily measured in fish caught. Being in the great outdoors with great companions counts as much or more. And by this standard, the trip was a home run.

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A photograph of a snowy forest with many thin, light-colored tree trunks. In the foreground, two Marlboro cigarette packs are placed on the snow. The pack on the left is red and white, labeled 'Marlboro' and '100's'. The pack on the right is yellow and white, labeled 'Marlboro' and '100's'. The text 'Come to where the flavor is.' is overlaid in large white letters across the middle of the image.

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av. per cigarette, FTC Report Feb '85







# ELECTRONICS

BY STEPHEN A. BOOTH

## Direct-To-Disc Recording

**F**OR THE TIME being, copyright issues are keeping digital audio tape (DAT) recorders out of circulation in the U.S. So let's discuss yet another digital recording format just over the horizon, namely, recordable compact disc.

Though it might come as a surprise to a generation brought up on Memorex, home recording predates the availability of open-reel tape decks in the 1950s. By the 1930s, amateurs armed with portable transcription phonographs were recording music and speech onto blank discs made of a soft acetate material. Many of these unauthorized "acetates," cut outside the confines of a studio, preserved for later generations the big swing bands and obscure folk musicians in live performances.

Magnetic tape, with its relatively convenient handling and longer recording time, has gained much greater popularity than the fragile, 3-minute acetates ever achieved. But with the advent of the digital audio compact disc—some 75 minutes long and physically robust—direct-to-disc home recording begins to appear practical again.

At the 1984 Tokyo Audio Fair, Sanyo demonstrated a prototype CD capable of putting 30 minutes of music on a blank disc. By the following year's fair, the prototype was up to 45 minutes of recording time.

CD recorders vanished from subsequent fairs as not-for-sale DAT decks hogged the limelight. Then, last spring, Radio Shack parent Tandy Corp. raised eyebrows when it announced its development of a CD-compatible recorder that could reach the market by 1990 at less than \$500. More recent-



You'll record digital compact discs at home with Tandy's THOR-CD.

ly, Japan's Taiyo Yuden unveiled a similar technology that the company states could be "reasonably priced."

Although Tandy and Taiyo Yuden have yet to describe their respective systems in detail, each has revealed enough to arrive at a basic understanding of the products and processes. The systems are alike in some ways, and different in others.

The most important shared characteristic is that discs recorded on the Tandy or Taiyo Yuden hardware conform to the Philips-Sony specifications for compact disc—meaning that they are compatible for playback on

any CD player. The key difference is that Tandy's recordable discs may be erased by the user and rerecorded many times. Tandy has reported as many as 40 recordings with no signal degeneration. Discs recorded by the Taiyo Yuden process cannot be erased and reused. In industry terminology, the permanently recorded Taiyo Yuden disc is called a CD-R. The erasable Tandy platter carries the CD-E acronym.

Both Tandy and Taiyo Yuden employ lasers to apply digital information to a recordable disc of the same 4 1/4 in. dia. of a prerecorded

CD. The newer 3-in. mini CDs also will be available as recordable blanks. Both companies use one of the three laser-optical recording processes that have been under development for this purpose—specifically, the one called pit-forming.

A conventional, prerecorded CD contains a microscopic spiral of depressions on the reflective surface beneath the clear, smooth coating of its playing side. The varying brightness of the light reflected back to the laser pickup from this irregular surface conveys the digital code of zeros and ones. In CD manufacturing, a laser etches the digital code on a glass master. Reflective replicates of this pattern, created by a metal (usually aluminum) deposition process, are sandwiched within the protective polycarbonate exterior of the CD.

The Tandy and Taiyo Yuden CD blanks also have a polycarbonate shell, but concealed within is a layer of chemical dye. When exposed to the on-off pulsing of a laser lightbeam more intense than that normally used for CD playback, the dye layer develops into a spiral pattern of depressions.

*(Please turn to page 43)*

## Solid-State Digital Snapshots

Just as the first filmless, magnetic disk cameras are arriving in stores ("Electronics," page 42, Jan. '89), Fuji has added a new twist to all-electronic photography.

In place of the spinning magnetic disk used by Canon, Sony and others, Fuji's experimental DS-1P Digital Still Camera uses a stationary, 16-megabit memory card to store color images.

This credit-card size digital memory, jointly developed with Toshiba, enables the prototype point-and-shooter to store either five full-frame TV photos, or 10 photos in the single TV-field mode. According to Fuji, future versions of the memory card will accommodate up to 40 full-frame images. Current magnetic disk cameras hold either 25 full-frame or 50 single-field pictures.

Capacity aside, an advantage of the digital memory card is its lack of moving parts.





After recording, these depressions reflect back as zeros and ones to light from a laser beam of normal, playback intensity. The pattern laid down by the writing beam corresponds to the digitized signal of the input source—be it live sound through a microphone or canned (CD, LP and so on). At press time, neither Taiyo Yuden nor Tandy would divulge whether their machines have direct-digital inputs and outputs. Consumer DAT decks do not have digital input jacks. This means that the input source—even from a CD player with a digital output jack—must first pass through an analog stage before it is recorded digitally.

Regarding the software, regular CDs hold up to 75 minutes of audio, or some 550 megabytes of data (for CD-ROMs). Taiyo Yuden says the capacity of its gold-tinted CD-R is the same as conventional CDs and CD-ROMs. Tandy describes the blue-tinted CD-E (which the company calls THOR-CD, for Tandy High-Intensity Optical Recording) as having storage capacity for 74 minutes of sound or 550 megabytes of data. But questions remain concerning the longevity of the discs. Tandy says that although erasable by laser, the pits of its optical disc are environmentally stable and permanent in nature. Taiyo Yuden rates lifespan of the nonerasable pits of its CD-R as 10 years minimum.

This vagueness from the product developers is not an intentional smoke-screen. Fact is, optical recording still has frontiers that have yet to be mapped. As details become available, they'll be reported in future columns—along with news of other recordable CD systems that the Tandy and Taiyo Yuden announcements are sure to chase out of the woodwork.

## Better Cassettes

The compact disc is the best sounding medium for music today, but this doesn't mean that prerecorded cassettes can't sound any better than they do. This year, buyers looking for premium quality in cassettes should look for the letters DAAD on the package.

DAAD stands for Digital Audio Analog Duplication, a new mastering process developed by American Multimedia. It replaces the analog master tape normally used in cassette duplication with a digital master.

Cassettes made from analog masters are subject to the distortion and noise inherent in the analog format. These problems become more evident during high-speed duplication because noise and distortion increase as the master tape wears out. With DAAD, the digitized master never wears out, so there is no degradation in sound quality no matter how many copies are made. In

fact, it allows cassettes to be duplicated at a faster rate. The industry standard speed is 64:1, but with DAAD the copying speed can be increased to 80:1 without affecting sound quality. More importantly, the 80:1 cassette sounds like it was made at a 1:1 rate.

DAAD may also have implications as far as pricing is concerned. If 25 percent more cassettes can be made in the same amount of time due to the faster duplication speeds, then the savings incurred may result in lower prices. If prices do drop, it won't be right away, as the cost of conversion to DAAD is estimated at

more than \$100,000 per production line. The record companies will have to get back that investment before prices fall.

Despite the initial investment, DAAD is likely to be used by many labels. Telarc, a label respected for its devotion to sound quality, has been impressed enough with DAAD to enter the cassette market for the first time. Telarc's first 10 cassette titles, recorded on TDK SA Type II tape, all use the DAAD process. Telarc won't be alone for long. Officials at American Multimedia report RCA and Warner Bros. are converting their facilities to DAAD. **PM**



## Why radar makes mistakes. How to protect yourself.

It's hard to believe, but traffic radar does not identify which vehicle is responsible for the speed displayed. It shows only a speed number. The radar operator must decide who to blame.

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# FREEWHEELING

BY TONY SWAN

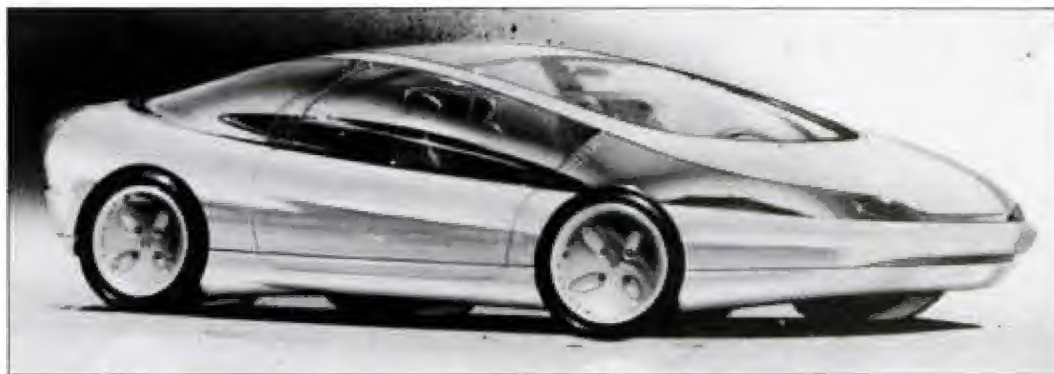
## Designs On Tomorrow

**W**HILE IT'S one thing for people directly involved with automotive design to speculate on the looks of the car of tomorrow, it's quite another for tomorrow's designers to do so. The men and women working in automotive design today spend the bulk of their time shaping cars that will make showroom appearances in five years or less. The men and women who, as yet, can only aspire to such jobs are unfettered by the constraints of corporate financial management and all the other influences that have traditionally tended to pull designs down toward a lowest common denominator. Which means the cars locked up in the heads of would-be designers are usually much more exciting than what you're likely to see in any showroom. And that's what makes the *Automobile Quarterly* Car Design Contest interesting.

For 1988, its second year, the AQ competition invited design hopefuls to project the basic essence of five current production cars a decade into the future. The only constraints were that the designs should preserve the basic dimensions of the cars—the Honda CRX, Cadillac Brougham, Jaguar XJ-S, Lamborghini Countach and Jeep Wagoneer—and maintain production viability.



Design student David Allen created this late '90s Jeep Cherokee.



If design contest winner Jeff Perkins is right, the 1999 Honda CRX will look like this.

ty. The '88 contest, which wrapped up last September, drew 190 entries, a great many of them from the Detroit area. Judges were Dick Teague, former head of AMC styling, Ted Finney, a Design Executive working on specialty car exteriors at Ford, Jerry Grove, president of the College of Art and Design at Detroit's Center for Creative Studies, John Herlitz, director of Exterior Design at Chrysler Corp., and Robert Cumberland, automotive design editor for *Automobile* magazine.

Judging was performed in two categories—Scholastic, 18 years and under, and Open, for 19 and up—and the judging was tough. As an example, the panel refused to name a winning design for the Jeep in the Scholastic division, citing the failure of entrants to satisfactorily meet the criteria.

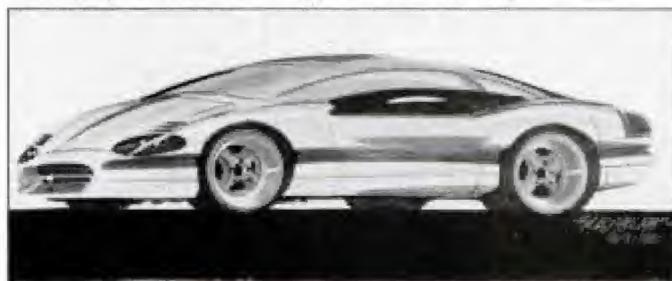
But seven entrants suffi-

ciently impressed the judges to take category honors. Of these, 16-year-old Brad Palmer, who is taking the high-school course at the Center for Creative Studies (CCS), emerged as the big winner with blue-ribbon entries for the Jaguar, Cadillac and Lamborghini. Palmer's Jaguar design accompanies this story. Thomas Skulley,

North Park Rd., Wyomissing, PA 19610-2918.

### A Footnote To Flight 103

While the tragedy of Pan Am Flight 103 late last year touched all Americans in one way or another, members of the automotive press—this member in particular—felt a keen sense of personal loss at



Jag XJ-S rendering was one of three winners for Brad Palmer.

an 18-year-old from Worthington, Ohio, was the other Scholastic division winner for his CRX design.

Open division winners were: Jeff Perkins, Rochester, Michigan, Honda CRX; Brian Janik, Detroit, Jaguar XJ-S; Bryan Bergero, Detroit, Cadillac Brougham; Doug Ungemach, Detroit, Lamborghini Countach; David Allen, Royal Oak, Michigan, Jeep Wagoneer.

We congratulate the AQ contest winners, as well as AQ for its sponsorship.

For information concerning the 1989 contest, contact Martha Teel at AQ, 420

the death of Volkswagen of America Executive Vice President Jim Fuller.

A charismatic executive and tireless traveler, Jim Fuller was that rare blend of capable manager and compassionate leader who turns up all-too-seldom. Relaxed, informed and possessed of an irreverent sense of humor, he was a hands-on enthusiast and a man who leaves an inordinately large number of friends to mourn him.

We are proud to count ourselves as members of this circle. Mr. Fuller will be sorely missed.

(Please turn to page 36)



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## FREEWHEELING (Continued from page 35)

### The High-End Buyer's Market

It's hard to link bargain hunting with cars costing \$30,000 or more, but when you stop to think about it, the luxury segment is looking more and more like a buyer's market. Already somewhat overpopulated, the high-end segment promises to have more than a little distressed inventory on its hands in the not-too-distant future, perhaps even as early as the end of the 1990 model year.

That year promises to be a watershed, because it marks the official debut of two new luxury lines from Japan—Lexus, the new Toyota marketing division, and Infiniti, its opposite number from Nissan. Cast in the image of Honda's highly successful Acura division, both will offer high-tech flagship sedans in the \$30,000 range, and both should be available in sufficient quantity to put a dent in the sales of traditional luxury makes like Cadillac, Lincoln, Jaguar, BMW and even Mercedes.

While this may not be very good news from the point of view of established players in the high-end market, it gives every promise of putting more bargaining leverage in the hands of individuals shopping for such cars.

What this competition should provoke in the short run is a lot of excellent luxury cars of exceptional value. The long run could be a little more gloomy, especially for low-volume European producers who lack the resources to produce all-new cars every three years.

### The Manhattan Exclusion

We were battling Fifth Avenue traffic a few days ago when a radio ad began extolling a new promotion by a major car rental company. The deal offered rock-bottom rates for Chrysler New Yorkers. The zinger: The New Yorker deal did not apply to the agency's Manhattan locations.

### Essentially Buick

Although there are plenty of Buick dealers who would love to have this sleek sedan in their showrooms right now, they won't see it—or a derivative—before the early '90s.

Dubbed the Park Avenue Essence, this is one of several concept cars Buick has been working on as the division seeks to reestablish its image after several years of vacillation and slow sales.

GM Advanced Design Chief Jerry Palmer, who oversaw the Essence pro-

gram, calls the car "an accurate look at Buick's thoughts for the future. It's a true luxury touring sedan."

Phil Garcia, chief of Advanced Design Studio No. 1, had direct responsibility for the project, while Ed Donaldson supervised the car's interior.

While the fluid lines are far from radical, they're clearly an evolutionary step farther down the road, and it is complemented by the car's interior design. The gentle curves help to mask its considerable size—210 in. overall on a 113.8-in. wheelbase, which creates sufficient in-



Buick's Essence show car may be blueprint for next Park Avenue.

terior volume for 3-across seating.

As you'd expect of a Buick show car, there's a long inventory of power accessories, including individualized climate controls for driver and passengers. Of particular interest, however, is the small CRT screen that flashes information from the car's new GM Delco Navicar system. An update on the old ETAK system, Navicar continuously tracks the car's location from a driver-selected starting point.

Another intriguing item from the electronic goodies bag is a multimedia (AM/FM/cassette/CD) quad-control sound system with individual controls for the three passenger headsets. The headsets use infrared sound transmission to eliminate cords.

For all its fluidity, the Essence still manages to look aggressive for a big sedan. Part of this may be attributable to the "fast" windshield—the rake is 65½°, 8° more than the '89 Park Avenue Ultra. The car's extrawide track also contributes to this impression. It adds about 2 in. front and 2½ in. rear to the current 60.3/59.8-in. dimensions.

Power is another important element in the reinvention of the Buick, and the Essence reflects this with a massaged version of the GM 3800 V6 engine. Tweaks to the heads, intake manifold and port injection system give this version of the 3800 185 hp at 4400 rpm, versus 165 for the current production engine.

How much of this car will you see in future Buicks? Divisional executives say the jury's out until they review reaction from car show audiences across the country, which means late spring. Stay tuned.

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See NASA Tech Briefs for technical details,

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# INSIDE DETROIT

BY JIM DUNNE

## Buick Ready With Regal 4-Door

**S**LEEK and traditional are words that best describe the 4-door version of the Buick Regal, which is slated for introduction later this year.

In keeping with Buick's newly assigned role at GM—division executives characterize their mission as the building of "premium American motorcars"—the Regal line avoids styling extremes, and is aimed at reminding conservative buyers of established styles that they may find more comfortable.

That doesn't mean that Regal should be perceived as old fashioned. It has the same basic powertrain as the flashier Pontiac Grand Prix and Olds Cutlass Supreme. In addition, Regal's conservative styling has more than a hint of the contemporary aerodynamic look, and could be just as popular with buyers as certain competitors already are—Buick will position the 4-door Regal against the highly successful Ford Taurus.

### Imperial Comeback

Although it was expected to be on the market before now, Chrysler's New Yorker-based Imperial luxury sedan should be ready for model year 1990.

A rear view of the Chrysler flagship reveals many styling cues carried over from the current New Yorker sedan, including bumpers



Buick's 4-door Regal, due for 1990, is expected to take a bite of the Ford Taurus market.

and side trim. Grillwork is also the same.

However, the New Yorker's 104.3-in. wheelbase has been stretched by at least 4 in., a change designed to improve rear-seat entry and exit, as well as legroom.

The opera window is the most identifiable styling feature to set this car apart from the New Yorker.

### Escort Turning Japanese

This 1991 Escort prototype has an all-new face that bears a strong resemblance to a number of the newer Japanese subcompacts.

The large bumper, squinty headlights and sloping hoodline are typical of newer models coming in from Japan.

However, at the same time, the front end retains a Ford family look, particularly with Taurus and Tempo.

Note that the front end clip of this car does not match the lines in the doors—an indication that the door styling and

window glass shown here is not the final design.

### Stealth Honda

That Honda TV ad showing the B2 Stealth Bomber beat the official government unveiling of the radar-invisible bird by a couple of months. Even so, the mockup shown

### Olds Truck?

Insiders look for Oldsmobile to get a version of the S-15 Jimmy 4wd sport/utility vehicle in a year or two.

The possibility was proposed by General Motors' management to Olds dealers as a way of appeasing them



Nose of '91 Ford Escort suggests strong Japanese influence.

in the advertisement is uncannily accurate.

Honda sources say the design for the model in the ads came from two main sources—a Stealth model kit and employment advertisements put out by Northrop Corp., the plane's builder.

A Hollywood set builder had the full-size model completed in about a month. One shortcut in the project was to use a rear window of an '82 Corvette as the windshield of the Stealth.

for the absence of a specialty vehicle like Corvette or Allante.

Whether Olds would get its own brand or share the Jimmy name with General Motors Corp. is yet to be decided.

The Jimmy proposal is in addition to Oldsmobile dealers getting their own version of GM's 1990 Aerovan, which will initially be sold as the Chevy Lumina and Pontiac TransSport.

(Please turn to page 40)



Chrysler Imperial rides on stretched New Yorker chassis.



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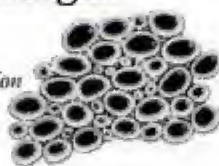
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And at the bottom, there's the Extended Wear Wedge sole. It's made of oil resistant polyurethane which is ultra-light and abrasion resistant. In short, the sole will last longer.

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## In-House Allante

Insiders predict that Cadillac will pull out of its deal with Italian coachbuilder Pininfarina when a new body style is introduced in three years.

Instead of importing Allante bodies from Italy, Cadillac will build its own bodies in the Allante final assembly plant in Detroit.

If the change is made, it can be attributed to Allante's poor sales record. The \$56,000 luxury sports car is selling at about 3500 per year—about half the rate General Motors forecast when the contract with Pininfarina was an-

nounced three years ago. At the lower volume, the Italian connection may be too expensive for GM to profitably maintain.

## Hot-Rod Lincoln

Look for word to leak out that Ford is testing a 2-seat luxury sports coupe that will compete in the mid-1990s against GM's Allante and Reatta, as well as some of the high-roller German coupes.

While details are still tightly guarded at Ford, it is likely the car will carry a Lincoln badge.

Power will come from a high-per-

formance 32-valve version of Ford's soon-to-be-introduced 4.6-liter V8, and the chassis configuration will be front engine, rear drive.

Other technical details expected for the new car include antispin traction control, adjustable suspension and solar reactive glass.

Interiors will be roomy, along the lines of the Buick Reatta, with plenty of storage behind the seats.

Ford's motive for getting into the highly competitive luxury sports car market is to maintain a prestige car reputation that exceeds Allante and Chrysler's TC by Maserati.

## John Bull Taurus

If you see this modified Taurus looming in your rearview mirrors, you'll know that Ford has been successful in its efforts to modify the popular sedan for police work.

Besides giving the Taurus high-performance capabilities, Ford will also



Ford is prepping Taurus for cop car duty.

have to convince police departments that front-wheel drive is better than rear drive, something that may not be easy to do with organizations currently using Crown Vics or Mustangs.

This prototype police special is identifiable by its twin spotlights, king-size side mirrors, extra grille openings and beefy tires.

## Basically Fun

Plymouth has announced a new concept car that could redefine how fun and basic practicality can be combined in one tidy package.

Called the Speedster, the car is a 2-seat convertible that seems to be conceived specifically for students on holidays like spring break or a weekend at the beach. The inside, for example, can be cleaned out with a hose, vinyl-covered seats and all.

The Speedster is built around a mid-engine, rear-drive chassis and also features a detachable hardtop.

Chrysler is vague about production plans for the Speedster, but design staff members expect elements of the car to show up in other products. If the car was to go on the market tomorrow, Chrysler estimates a suggested retail of about \$10,000.

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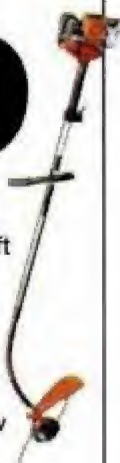


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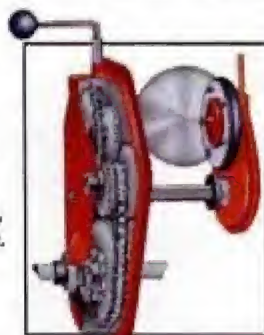
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# CAR CLINIC

BY MORT SCHULTZ

## Gee-Whiz SG Oil

**B**ACK in January of 1987, "Car Clinic" told you SG was coming to town (page 37). Well, it has arrived. SG is the newest category to be included in the American Petroleum Institute (API) engine oil service classification system. Three organizations—API, the American Society for Testing and Materials (ASTM), and the Society of Automotive Engineers (SAE)—have established standards that oil must meet to be awarded the SG designation.

Oil bearing the SG symbol contains more additives than oil bearing the SF or SE symbol. According to API, these additives "provide improved control of engine deposits, oil

oxidation and engine wear relative to oils developed for previous categories."

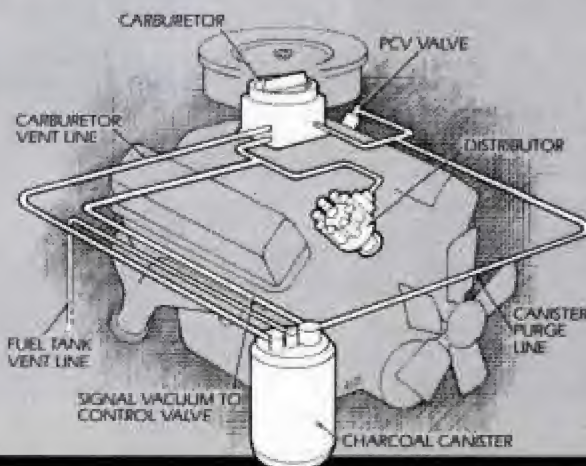
What does this mean as far as you're concerned? For one thing, you'll probably pay a higher price per quart to buy SG oil than someone who uses oil designated SF or SE. For another, you may not have a choice but to use SG oil if you own a 1989 car, van or light truck. SG oil may be required by the manufacturer to maintain the warranty. Find out by reading your warranty agreement.

You could, if you wish, use oil designated SG in the engine of a pre-1989 vehicle. And SF oil will be disappearing from the market, as SE virtually has.

## Can Of Worms

Let's pretend your carbureted engine chokes up, fouls sparkplugs or gets you turned down flat at a state inspection because of a high carbon monoxide (CO) reading.

All specs seem to be on target, so the next step is to disassemble the carburetor, right? Wrong! The next step is to take another CO reading, but this time after you disconnect the hose from the carburetor bowl, vent at the much-disregarded charcoal canister of the fuel evaporation control system. If that CO reading now shows a significant drop, coming to rest in the normal (1 percent or less) range, suspect that over the years the charcoal canister has loaded up with raw gas, which is being drawn into the carburetor and is disrupting the normal fuel mixture. A new canister should solve your problem.



## Poor Pawl

The automatic transmission of our 1984 Chrysler Fifth Avenue is extremely hard to shift out of PARK when we park it noseup in our driveway, which is a steep incline. Can you help? SID MORTON  
CAMDEN, NJ

This is a heavy car. When that weight comes to bear on the parking mechanism in the transmission, it takes muscle to pull the transmission out of PARK. That's why the procedure recommended by Chrysler to park the car on an incline should be followed with this car or any vehicle with an automatic trans, as it's not a situation unique to Chryslers. Before removing your foot from the brake, set the parking brake securely and then shift into PARK—in that order.

However, there are 1987 and older Chrysler-made vehicles equipped with front-wheel-drive (fwd) automatic transmissions that are experiencing the same condition you are having with your rear-wheel-drive (rwd) Fifth Avenue. To resolve the problem in fwd vehicles, Chrysler issued technical service bulletin (TSB) 21-14-87, which is titled High Pullout Effort From Park when parked on a steep grade. This TSB gives a clue as to what could be going on with your rwd car.

The TSB cites the cause of the condition in fwd automatic transmissions as "improper park rod bullet hardness" and also the possibility that the force needed to shift these fwd transmissions has resulted in a bent control lever. A bent control lever makes it even harder to shift out of PARK.

As with fwd transaxles, a

part of the parking mechanism in your transmission (the parking pawl to be exact) may not be up to the task. Therefore, you and others experiencing this with rwd transmissions should have a new parking pawl installed if the Chrysler-recommended parking procedure doesn't work.

The parking pawl for your automatic transmission now being sold in the parts departments of Chrysler dealers is a stouter unit than the original. In replacing the pawl, you should make sure the control rod lever hasn't been bent. If it is, replace that too.

## Clutch Chitchat

The clutch pedal in my 1984 Chevy Camaro Z-28 doesn't release all the way. This failure to disengage is putting wear on the clutch. I've looked for a way to purge air from the hydraulic system, believing this would rid of the problem, but found none. Can you tell me how to bleed this system? MIKE DETLOFF  
PARKVILLE, MO

Before assuming that air trapped in the hydraulic system is causing your problem, there's a simple test you should make. Measure the travel of the slave cylinder rod. If the rod moves  $1\frac{5}{16}$  to 1 in., the clutch pedal is not the result of a defective hydraulic system. Areas you should look to instead are the clutch fork (it may be bent), the ball pivot in the bell-housing on which the clutch fork rides (it may be worn), the throw-out bearing (it, too, may be worn) and the pressure plate (it may be shot).

Incredible as it may seem, no provision is made to bleed the hydraulic system

(Please turn to page 46)



of your '84 Camaro clutch. Firebird owners of this vintage are in the same boat. If air is trapped and is causing the sluggish clutch pedal, you have to replace the entire assembly. Fortunately, the replacement parts are the same as the '85 and later vehicles—and they have a bleed screw.

## Gone But Not Forgiven

At the time I purchased my new 1982 Chevrolet pickup, I paid \$159 to have it rustproofed with Polyglycoat. As part of the deal, I got a lifetime warranty. I am presently experiencing rust-through areas on both doors. A letter sent to Polyglycoat Warranty Group in Boca Raton, Florida, came back marked "no forwarding address." Is Polyglycoat out of business? If so, who is responsible for the lifetime warranty?

JEFFREY BESOLD  
CENTEREACH, NY

*Polyglycoat Co. went bankrupt. We're sorry to say the lifetime warranty isn't worth the paper it's written on.*

## Bureaucratic Injustice

I have a 1986 Chevrolet Caprice. At a state inspection when the car had been driven just 7000 miles, I was told the idler arm had to be replaced. This inspection was performed by raising the front end and moving the wheel back and forth. A new idler arm cost me \$64. In the August '88 "Car Clinic" (page 28), you stated that this was not the correct way to test an idler arm. I showed this to the inspection station and they said, "Those magazines don't know what they're talking about." Who's correct?

R. B. STUMP  
GREENSBURG, PA

*Is there really any doubt? This method state motor vehicle inspectors are using is condemning good idler arms to the scrap heap. Motorists who have to pay the freight for this should start writing their state legislators to have the inspection procedure changed.*

*Let's use some common sense. Having an idler arm wear out in 7000 miles is virtually impossible. If a manufacturer had a line of cars that exhibited this kind of serious safety problem, you could bet that the Center for Auto Safety and/or the National Highway Traffic Safety Administration would demand a recall.*

*Do state inspectors really believe that they're right and GM is wrong? Here's the testing procedure recommended in the Chevrolet shop manual (shop manuals of other manufacturers suggest the same or a similar method):*

*"The idler arm assembly should be replaced when an up-and-down force of 110 Newtons (25 pounds) is applied*

*at the intermediate rod end of the idler arm and, the vertical lash exceeds 3.18 mm (1/8 in.).*

*"Jerking the right wheel and tire assembly back and forth, thus causing an up-and-down movement of the idler arm, is not an acceptable method of checking, because there is no control on the amount of force being applied."*

## Saving Ignition Modules

Can you give me one good reason why the ignition modules in my Ford Escort go bad so fast? The car has gone through

four in all, counting the original one. Each lasts six to eight months. There's no warning of failure. The engine just dies in its tracks. Thanks for any help you can give me.

J. A. FILHORN  
BRIDGEVILLE, PA

*You've probably been installing new ignition modules needlessly. Filling the upper right-hand mounting hole of the thick film ignition (TFI) module housing with silicone grease will prevent moisture from entering the housing—short-circuiting the module and causing the engine to stall.*

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The boys swimming  
off the side.  
And my Johnson outboard.



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## Rumor Squisher

Can you tell me if it's true that I can't install steel-belted radials on my 1971 Oldsmobile 98 because the suspension system is not tuned for radials? I've been told that radials will damage the suspension. Up to now, I've been using bias-ply tires, but I'm getting only 20,000 miles from a set. I want to switch to radials, if possible, to derive the benefit of longer mileage. What do you say?

JOHN GUIDICE  
QUEENS, NY

Engineers at Firestone and Goodyear

say nonsense—that you will not damage the suspension system of your old Olds by switching to radials. Older cars were tuned for ride and handling to match the characteristics of bias-plys. Therefore, you may find that once you install radials, you aren't pleased with the ride or handling. The feel will be firmer, perhaps even harsh,

### DO YOU HAVE A CAR PROBLEM?

Just ask Murt about it. Send your question to Car Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

you may get some tire squirm that you feel as steering wheel vibration, and hear rattles never heard before.

There's another point: A high-quality set of belted-bias tires can last almost, if not as long, as a set of radials provided wheel alignment is on the money, tire/wheel/brake assemblies are balanced, and you take pains to keep inflation pressure at the level recommended by the tire company.

## Mean Lean

I was leaning against the left front fender of my 4-month-old 1988 Toyota Camry the other day when I momentarily lost my balance and pushed my hip against the metal. This put a dent in the fender that will cost me \$329 to get fixed.

RICHARD C. DAVENPORT  
LOS ANGELES, CA

Frankly, I think Mr. Davenport's body shop took him for a ride—\$329 to have a dent straightened is ludicrous. Even in the old days when cars were made with heavier, gauge metal, we often were able to straighten a dent without disrupting the paint by rapping it from the rear with a rubber mallet or even a fist. In some cases, we could use a plumber's helper to pull metal back into shape. In any event, Mr. Davenport's experience with his Toyota should serve as a warning to avoid using a car as a leaning post. **PM**

### SERVICE TIPS

■ An unsteady idling speed from a 1987 or 1988 Ford Escort may be caused by water getting into the 8-pin wire harness connector that's lying on the right-hand shock tower. This results in false signals being sent to the EEC IV processor. TSB 88-22-6 offers the repair, which is to be done free of charge under the basic or emissions control systems (50,000 mile) warranty.

■ As your 1987 or 1988 Chrysler Corp. 3-liter engine gets on in years, engine crank time may get longer and longer. If starting begins to exceed 3 seconds and no driveability test procedure turns up the reason, the dealer is authorized by TSB 18-16-88 to install different fuel injectors (part No. MD132249) free of charge. The offer is good for five years or 50,000 miles, whichever occurs first.

■ From now on, use the newly issued rubber thermostat gasket (part No. 25535939) in your 1988 Pontiac Bonneville 3.8-liter engine. It's the same one that's used in 1989 Bonneys and does a lot better job of sealing than the paper gasket which was installed originally.

■ A 1988 Honda Prelude automatic transmission which gets stuck in Fourth gear, giving poor acceleration and/or no 4-3 or 4-2 kickdown, should be tested according to TSB 88-027. The unit may need a different shift solenoid assembly (Honda Control No. 2962074).



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## President Bush And The World Of Science

**A**MERICA'S quadrennial renewal has furnished us with a new president. Fresh beginnings—along with a few hangovers—are in the political wind.

Ask anyone in the scientific community what Mr. Bush's most important task will be in coming weeks and the response is virtually unanimous: Promote a qualified science adviser who can enhance, and even reform, the way science information is imparted to the president. Give the job to a science professional or academician of high standing, and make the office co-equal to that of the national security adviser.

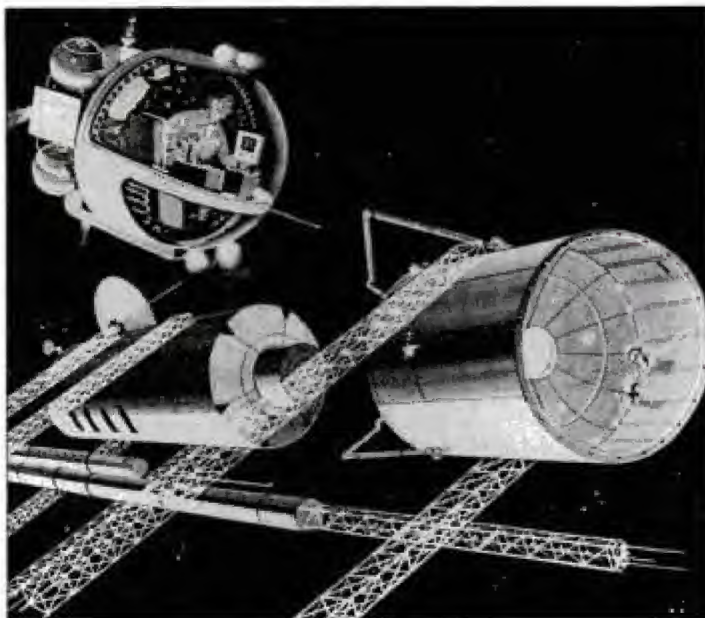
In so doing, Mr. Bush will be providing the executive branch with a science czar who can interact with the scientific community, with the various scientific offices within individual agencies, with the National Science Foundation, and with the Oval Office. By elevating the status of science adviser to the president, he'll go a long way toward setting vital national priorities.

### Pervasive influences

The reasons we need a stronger science office at the White House are as diverse as the number and types of federal agencies—from Health and Human Services to Transportation.

Some examples:

- The Department of Energy is grappling with design requirements for the Superconducting Super Collider, the mammoth \$5 billion particle physics experiment that scientists hope will unlock the secrets of basic matter. Capturing the elusive Higgs Boson and other particles is the goal in a project that may take years to complete.



Plans for tomorrow's space stations begin with today's decisions.

- High-speed magnetic levitation trains that could decongest our air corridors are being pursued in Japan (with the HSST) and Germany (with the Transrapid). America has no coherent policy to exploit emerging rail technology.

- The AIDS virus is out of control in many major cities, prompting health officials to warn of threats to broader segments of the population.

- Global warming and oceanic phenomenon like El Niño are beginning to have a profound influence on crop production and ecology along our coasts, where most people live.

- Technologies that will permit a space-based defense against intercontinental ballistic missiles are tantalizingly near, according to Air Force and Army planners. And high-ticket strategic aircraft like the B-2 Stealth Bomber, designed to seek and destroy mobile targets and other high-value sites, are undergoing testing and evaluation. The costs of these military programs are

nothing short of astronomical. Determining their ultimate value to the nation requires scientific scrutiny.

- Our nation's space program, still reeling after the 1986 Challenger catastrophe, needs a significant commitment from government and from taxpayers if we are to remain a space power. The Space Station, our toehold for any kind of future in space, hangs in the balance. At no other time in our nation's history has science and technology touched us more, affecting virtually every aspect of modern government—from defense, to commerce, to energy. Science and technology permeates every aspect of modern living, and our nation's health—fiscal and physical—depends on choices we'll soon be making in numerous high-tech areas.

### Past examples

The position of science adviser to the president has changed since President Truman installed William T. Golden in the chair almost

four decades ago. The sputnik scare prompted President Eisenhower to select MIT president James R. Killian for the role, who established the President's Science and Advisory Council (PSAC). The position of science adviser grew in importance and stature throughout the '60s and early '70s, counseling the president and high executive branch officials on matters pertaining primarily to defense. President Nixon abolished PSAC in 1973 over policy quarrels. But President Carter reinstated the science adviser to the president, and the position has grown in importance as technology issues have begun to dominate the nation's headlines. AIDS, SDI, superconductivity, nuclear power and strategic defense are all issues that have crossed the desks of President Reagan's two science advisers, George A. Keyworth II and William Graham.

### Prospects

There are positive signs that President Bush understands the increasingly important linkage between science and public policy. He told *Science Magazine* just before the election: "There is virtually no aspect of government that does not involve science and technology, and I plan to avail myself of the best advice on such matters." The president's public statements indicate a strong personal interest in science, and a commitment to bringing prudent science choices to government. After all, he says, "Technology is America's economic fountain of youth."

Even so, it will be interesting to watch the new administration's approach to vital science matters as the 1990s unfold.

PM



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Comparisons based on data available at time of publishing.  
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# OLD HOUSE RESTORATION

BY BOB VILA

## Iron Fences

**P**ICTURE in your mind a Victorian home and chances are you'll place an impressive black iron fence around its front yard. Commonly used as a way to define boundaries and property lines, the right fence can be the finishing touch to your restoration, greatly enhancing your property's appearance.

Many of these grand old houses still retain their original iron fencing. But for others, the repair work that's needed to restore them to their original grandeur is in the realm of the sophisticated do-it-yourselfer with lots of available time.

When the fence is in such a state of disrepair, perhaps you'll decide it will be cheaper in the long run to just replace it. Maybe no fence exists to begin with, and you want to add one. Fortunately, there are still ironwork shops supplying products suitable for the restoration market today.

### Adding a new fence

If you're starting from scratch, deciding what type of fence fits with your house is usually a matter of research. As in so many other areas of restoration work, old photos showing your property in its early days are often the key to unlocking this mystery.

Sometimes, the local historical or Victorian society can help with information on the type of fencing that was commonly used in your area. A walk around the neighborhood noting what designs and styles were used on neighboring properties can also get you thinking in the right direction.

*Contributing Editor Bob Vila is host of public television's "This Old House."*



Gates of wrought iron are often used in combination with other building materials, like these stone posts.

In general, the design of the fence should reflect the style of the house. The more ornate the architectural embellishments of the house, the more ornate the fence can be. Usually, the earlier the age of the house, the plainer the fence.

You should be able to find an appropriate stock iron fence design from one of the companies active in this field today. (A list of some suppliers follows.) If you're set on re-creating the exact design of your home's original fencing, having the fence custom designed is also an option.

### Restoring old ironwork

An iron fence can last for a long time—100 years or more—with the proper care.

In most cases, this care means protecting the fence from its main culprit: rust. It's best to inspect the fence every couple of years for signs of this. Any offending areas should be sanded down to the bare metal, then primed and repainted.

Unfortunately, many old fences, like the houses they surround, have been neglected. If that's the case with yours, and the fence is rusted, leaning, missing a few pieces or broken in places, you might be able to restore it. Many times, this involves sandblasting the entire fence to remove all the old paint and rust, then priming and painting to make the iron look like new again.

As far as the sandblasting goes, you can either hire a

pro or, if you feel fairly confident of your skills, rent the necessary equipment and do this job yourself. In either case, keep a close watch on the weather when you plan this job. Don't leave the bare metal exposed to the elements any longer than necessary, since it will rust extremely quickly. It's best to get a coat of rust inhibitive primer on it, preferably one with zinc chromate, the same day. Some folks double the primer coat and add a double coat of finish. Others feel a single coat of each is enough. If you live in a moist climate, I'd opt for the double coats to be on the safe side.

### Finding replacement pieces

The first step in fence restoration is making any physical repairs or replacements that are needed. Many times, a homeowner can do the work necessary to true-up a leaning fence, straightening out any bent pickets or posts along the way. Replacing missing pieces can be a bit more difficult.

First, you've got to locate the appropriate replacement parts. Depending on what you're looking for, a local ornamental or welding shop may be able to help. If not, you may be able to order the pieces from an ironwork or fencing company. If nothing seems appropriate, you'll have to resort to the custom replacement route. Many times, this involves cutting off a piece of the fence you want duplicated with a hacksaw and sending it away to be custom copied. If the item in question is made of cast iron, which requires a sculpted template or pattern of the piece you need, the startup costs for this work can be astronomical. Wrought iron,

*(Please turn to page 55)*



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Road & Track, Nov. 1988



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**"...Vector 3 maintains a BEL tradition of excellent sensitivity, posting the highest figures in this survey for both K and X band radar." *Road & Track*, Nov '88**

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radar, now increasing in use throughout the U.S. and Canada. And VECTOR 3 also effectively reduces false alerts from non-police sources without any loss of sensitivity to police radar.

### Laboratory Tests\*

Model	Sensitivity, dBm/cm <sup>2</sup>	
	X-band	K-band
BEL Vector 3	117.2	115.6
Audiovox RX-4	104.1	93.9
Cincinnati Microwave Escort	112.9	106.8
Cincinnati Microwave Passport	114.1	107.8
Cobra Trapshooter RD-3170	113.4	110.8
Fultron 15-0900, Snooper D-4000	109.4	108.8
Kraco KRD-16	102.7	104.7
Mascot PH222	101.5	94.6
Maxon RD-25	109.3	106.8
Radio Shack Micronta Road Patrol XK	107.6	106.0
Uniden RD9XL	113.1	108.8
Whistler Spectrum 2	115.6	110.4
Average unit	110.1	106.3

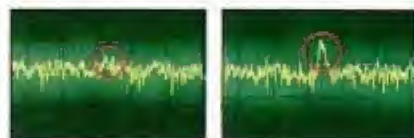
Source: *Road & Track*, Nov. 1988

\*Conducted by Advanced Product Evaluation Laboratory, Inc.

BEL VECTOR 3 is the only unit in this test that also detects Ka band radar.

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## OLD HOUSE RESTORATION

(Continued from page 50)

which is worked by hand, is easier and cheaper to replicate on this type of piecemeal basis.

If the finials, the fancy pieces that adorn picket tops, are made of a good grade of refined malleable iron and are a snug fit, they can sometimes be driven onto the picket tops. But many times replacing cast-iron finials and other fence parts requires welding. Is this something you can do yourself? If not, you'll have to hire a pro which, of course, raises the price of this restoration work.

One word of caution here: Many local welding shops don't have the expertise necessary to do this kind of work. Make sure the professional you decide on has experience welding iron fences. (Look at some of his past jobs if you can.) If it's not done right and the welds aren't ground smooth, the whole thing can end up looking choppy.

Another option to doing the repair work and painting it yourself is to actually remove the fence panels (they usually bolt to the posts) and ship them off for expert restoration by an ironwork or fence shop. Or, if you've got the budget and feel strongly enough about it, you could hire a specialist from one of these firms to come on site and restore your fence in the field. This, of course, is an expensive alternative that is usually reserved for museum-quality homes.

When all is said and done, you must decide if it's worth investing the time and money necessary to complete this restoration project. Sometimes, it may be cheaper in the long run to find a manufacturer who can duplicate the original. If the fence design is very simple, there may not be much difference in the cost of restoring it versus replacing it.



Cast-iron fencing was sometimes used in place of wrought iron.

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Keep in mind, though, that the restored value of the original may be more than that of a new iron fence.

### Going the salvage route

Some ingenious restorers have great luck and really enjoy hunting for old-house parts and pieces in their local sal-

vage yards or demolition sites. If you hit it just right, you may be able to salvage some of the missing pieces needed to complete your restoration.

You may even find enough iron panels to create a new fence (the posts you can always buy from an ironwork shop). Just be sure you find enough panels to fence in your area. If you have to mix-and-match the pieces to get the right amount, consider using salvaged fancy panels in the front of your property, with the simpler designs running along the sides.

Granted, restoring or replacing an iron fence is usually one of the last things you worry about when you take on an old-house restoration project. But it's nice to know that, depending on the condition of any existing ironwork, there's something you can do about it.

PM

### Iron Fencing Suppliers

- Architectural Iron Co., Box 126, Schoeopce Rd., Milford, PA 18337, (717) 296-7722
- Cassidy Bros. Forge, Inc., U.S. Route 1, Rowley, MA 01969, (508) 948-7303
- Custom Ironworks, Inc., P.O. Box 99, Union, KY 41091, (606) 384-4486
- Nostalgia, Inc., Architectural Antiques, 307 Stiles Ave., Savannah, GA 31401, (912) 232-2324
- The Stewart Iron Works Co., P.O. Box 2612, 20 W. 18th St., Covington, KY 41012, (606) 431-1985



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Kawasaki believes safety begins with us and ends with you. Drive responsibly. Jet Mate bears the "Class A" label and is subject to all applicable state and local boating laws. Always wear a USCG approved personal flotation device, neoprene and other appropriate safety apparel. Respect the right of shoreline residents and other marine users. Specifications and price subject to change without notice.Available in CA, FL, IL, MA, MN, MO, NY, PA, TX and WI.



# Save Gas, Save Engine with 'POLY'

**GUARANTEED LOWEST PRICE** (see details below)

The following introduces one of the most fully tested and proven gas saving, friction-reducing engine treatments ever to reach the market!

## The Secret is "Poly"

"Poly" is short for polytetrafluoroethylene (TFE), the slipperiest substance known to man. (1981 Guinness Book of World Records). Petrolori Corporation, makers of Slick 50, invented a way to permanently bind this slippery chemical to your engine with one treatment. Just one quart of Slick 50 can reduce engine friction, increase gas mileage and horsepower and reduce engine operating temperature, causing your oil and engine to last longer...plus it reduces metal wear, defraying costly overhauls.

## Years of Testing and Use Have Proved it True!

Slick 50 has been thoroughly tested in independent laboratories and out on the road:

The March/April 1982, p. 35 issue of "Consumer Digest" magazine stated, "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon."

One of the country's most respected research institutes reported applying a powerful ultrasonic cleaning process to a Slick 50 treated engine and were surprised at its permanence. "We actually expected the Petrolori Slick 50 TFE Resin coating to also be removed, but later found it was still there."

TUV, a German testing laboratory with credentials every bit as prestigious as our Underwriters Laboratories, tested Slick 50 in 1986. They found substantial increases in both gas mileage and horsepower. Their tests showed that these gains were due to a reduction in friction.

The Federal Aviation Administration has fully accepted a similar product for aircraft—Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). This FAA endurance test-simulated 1400 hours of engine use.

The power technology laboratory at a leading southwestern university stated, "Slick 50 does increase horsepower and decrease fuel consumption in tests done at the university."

The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a torture test overseen by the Automotive Services Council for Pennsylvania and shown on WTVE television. Three cars with 75,000 to 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage.



## It's Easy to Treat Your Engine

A few minutes before oil and filter change, add the engine flush you get free with each order to clean out the engine. Let the engine idle for 5 minutes. Then drain the oil, change the filter and add the proper amount of oil, less one quart. Add one quart of Slick 50, drive for 30 minutes, and leave it in the crankcase for at least 3,000 miles. As the engine operates, the oil carries the "Poly" between the parts where it is burnished into the pores of the metal.

## Only One Treatment Necessary

It's permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8-cylinder gasoline and diesel engines.

## Works with Most Oils

Slick 50 will work with all petroleum-based oils and all synthetics compatible with petroleum-based oils with the exception of graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

## 4 Ways Slick 50 Saves You Money

Your actual percentages may vary depending on your driving, vehicle condition, weather and geographic location, but no matter what your conditions, Slick 50 can:

1. Increase mileage
2. Increase horsepower (small economy cars and large RV's really need this)
3. Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine.
4. Minimize or eliminate costly overhauls by reducing engine wear

Up to 90% of the engine wear on a car can be caused by lubrication starvation cars experience when first started before the oil begins to circulate. Slick 50 can eliminate this problem for less than the cost of two tanks of gas.

## Slick 50 Will Not Affect Your Warranty

Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, this oil carries an American Petroleum Institute service classification SF-CC-CD.

## There's No Risk with Our Money Back Guarantee

Use Slick 50 for 3000 miles. If you don't notice an improvement in engine performance, return your invoice with a short note telling why, for a prompt full refund—no questions asked.

## Profit from Selling Slick 50 Yourself

Here's an opportunity to make handsome profits. Having such solid test results from major institutions make Slick 50 easier to sell than many other products. Free dealership information is sent upon request.

## GUARANTEED LOWEST PRICE!

If at time of purchase you have seen Slick 50 advertised in a current magazine at a lower price, we will beat that price by \$2.00 per quart.

For purchase or further information call toll-free 1-800-525-8624, ext. 3 (in California 1-800-233-9559) or send to: Progressive Energy Corporation, 255 South Bent Avenue, #B2, Dept. PM389, San Marcos, California 92069.

Yes, I want to improve my car's performance and save my engine—rush me risk free:

☐ One Slick 50 at \$39.95 + \$4.00 shipping and handling. Calif. Residents add 6 1/2% Sales Tax.

☐ Give me free shipping and handling for my order of 2 or more at \$39.95 each.

☐ Check ☐ C.O.D. ☐ Visa/MasterCard  
Card # \_\_\_\_\_

Exp. Date \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_  
(Give street address if possible for UPS delivery)

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**PEC**  
Progressive Energy Corporation

255 South Bent Avenue, #B2, Dept. PM389  
San Marcos, California 92069

CALL NOW, TOLL FREE 1-800-525-8624  
IN CALIFORNIA, TOLL FREE 1-800-233-9559.

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# How To Sharpen Spade Bits

BY ROSARIO CAPOTOSTO, Contributing Editor

**S**PADE BITS are extremely popular woodboring tools and there are three reasons why. First, spade bits are efficient, quick-cutting tools. Second, they're inexpensive. Prices range from about \$2 to \$4 for sizes from ¼ in. to 1½ in. dia. And finally, spade bits are easy to sharpen in the workshop.

Sharpening spade bits can be done on a bench grinder or with a file. For the best results, the original bevel of the cutting edges—usually 8°—should be maintained. It's also important to remove an equal amount of metal from each cutting edge.

When using a bench grinder, adjust the tool rest so that



Sharpen spade bits on bench grinder quickly and accurately. Adjust angle of tool rest to match original bevel angle of bit's cutting edges.

the grinding wheel matches the bevel of the bit's cutting edges. Then, tighten a depth-stop collar onto the bit's shank. The collar butts against the back edge of the tool rest. Advance the bit straight into the wheel, flip it over, and repeat this step to sharpen the second edge.

Hand-sharpening is done with a smooth-cut mill file. This can be done freehand, but for best results, make the simple hardwood guide block shown. The block's beveled top edges guide the file at the proper angle.

The Irwin Speedbor 2000 spade bit has two protruding spurs. This bit can't be sharpened on the grinder, but it can be hand-sharpened. **PM**



Attach a depth-stop collar to bit's shank. Collar butts against tool rest to control amount of metal removed from the cutting edges.



When sharpening spade bits with a file, make this simple guide block. Tighten depth-stop collar against the bottom of the block.



Using a mill file, make light strokes across angled top of guide block. Keep count of the strokes and repeat for the other edge.



Any wire edge (burr) that results from sharpening, can be removed on a flat sharpening stone. Lay bit flat on stone and rub lightly.



Use a file to sharpen bit's starting point, too. Hold file at same angle as point's original bevel. Make light strokes on each side.



Spade bits with sharp spurs protruding from the cutting edges, as shown, must be sharpened with a file. Use a small smooth-cut file.



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# THE RITES OF SPRING

A host of mid-year new-car introductions makes a banner year even better.



Nissan's 300ZX is new from the ground up, including a 300-hp, dohc, 4-valve turbo V6.

BY TONY SWAN, Automotive Editor

**L**IKE THE OBSCURE comic who owed everything to . . . timing, the automobile industry is no longer the predictable harbinger of seasons it once was. True, fall is still favored for most new-model rollouts. But more and more manufacturers are pursuing a policy of introducing their new cars whenever they're ready, regardless of what the calendar says.

As a result, the new-car reports we brought you in

our October and December 1988 issues are already a trifle out of date. Which is why we're presenting a tempting array of newcomers in the pages that follow.

While most of these '89½ cars will be available—as 1990 models—by the time you read this, we're also including a new nameplate that won't debut until November, simply to give you a first look. The new brand name is Infiniti, which is Nissan's answer to the new marketing divisions at Honda (Acura) and Toyota (Lexus).



## THE RITES OF SPRING

So whether you call the vehicles on these pages '89½s or not-quite-'90s, you can be glad you didn't have to wait until next year's model intros.

### Nissan 300ZX

Redesigning a successfully established car is always something to be approached cautiously, particularly when that car has a legend or two lurking in its heritage. Nevertheless, Nissan went well beyond minimums with its third renewal of the 300ZX. Although its sleek exterior may suggest that what we're seeing is only an evolutionary change, with updated styling and a few minor tweaks, this is an all-new Z-car—faster, slicker and, yes, better than its predecessors.

Very little remains of the previous car. The wheelbase has been stretched 5.1 in., while overall length has been reduced almost 4 in., simultaneously reducing front and rear overhang. Both the front and rear track have been expanded, while height has been reduced, yielding a much more stable platform for the sleek new bodywork.

It also adds up to a basic appearance change. For the first time since the original 240Z of 1970, Nissan has moved away from the classic long nose/short cabin look that was originally adapted from the old Ferrari 365 GTB/4 Daytona.

The all-independent suspension has also come in for a substantial redesign, employing an all-new independent multilink layout at the front. At the rear, the new Z uses a system of double upper control arms with a slanted lower A-arm and lateral links, similar in design to the rear suspension on the recently introduced—and well received—240SX.

Braking performance is nothing short of formidable, with 4-wheel vented discs using new aluminum alloy 4-piston calipers and augmented by a new antilock system.

Formidable also applies to what's going on under the hood. The old Z-



NISSAN 300ZX



Longer wheelbase, 57-hp boost make third-generation Z-Car the fastest ever.

car's smooth-running 3.0-liter V6 has undergone a complete overhaul—only the basic bore and stroke dimensions are the same—that includes new 4-valve cylinder heads, dual overhead cams, a new variable cam timing system, a much higher compression ratio and lots more horsepower: 222 hp at 6400 rpm versus 165 for its predecessor. An intercooled twin-turbo version still in development is expected to produce 300 hp.

The Z-car's new muscle finds its way to the rear wheels through a new 5-speed close-ratio transmission (or a 4-speed electronically controlled automatic) to a new viscous limited-slip differential. And the 5-speed has just about the slickest shifting factory linkage we've ever come across.

We drove the new 300ZX at Nissan's Tochigi proving grounds in Japan. And while a proving grounds drive is never a true test of the way a

car will ride and handle on the road, we were nevertheless duly impressed.

This is a car that works *with* you, not against you. This is a car that inspires confidence as soon as you climb behind the wheel. This is a car that is easy to drive fast. It will make a better driver out of almost anyone.

Gone are the bounding, pitching motions of the old Z-car. In their place is a firm, stable ride and precise, responsive handling. The engine is strong, and pulls well in any gear from any speed. While the acceleration in the normally aspirated version won't blow away any Corvettes, the turbocharged version might.

Nissan's Z-car has finally grown up. Now it's a world-class sports car.

We know the word awesome is no longer in vogue—but it certainly applies here.

—Joe Oldham

### Porsche 964

Driving the 911 Carrera 4 is like being with a high-school sweetheart many years later. The lines are familiar, but more mature. The handling is predictable. And an experience that once might have been only exhilarating becomes infinitely more satisfying.

To look at the picture, or even sitting in the car as it moves along the road, there's little new. The rear spoiler that moves up and down, and the new style alloy wheels, are really the only visual tip-offs that this isn't just an updated 911.



PORSCHE 964





VW CORRADO



Scirocco replacement sports 158-hp 8-valve supercharged motor, sub-8 second 0-60 time.

But a twist of the key is more illuminating. The air-cooled flat-6 engine has been punched out to 3.6 liters from last year's 3.2 and 1965's 2.0. There isn't much more than a few nuts and bolts that carries over. What the extra displacement means is more torque and horsepower, 228 V8-quality lb.-ft. of torque and 250 hp, for instantaneous acceleration at any rpm in any gear.

In fact, almost everything about the Carrera 4 (except for the part you see) is new. The chassis, built on the same production line as the 928, carries a completely new suspension. And the new suspension was necessitated by the introduction of 4-wheel drive.

Inspired by and derived from the 959, the new full-time 4wd system uses two hydraulically controlled multiplate clutches, one in the rear axle differential and one in the center diff. The rear locks at cornering accelerations above 0.5G, while the center uses information from the ABS brakes to sense any difference between front and rear wheel speeds. When one end of the car loses traction, the diff locks.

But the rationale for the 4wd system wasn't an ongoing quest for adequate traction. With the engine hanging cantilevered behind the drive wheels, 911s have never really had a problem putting the horsepower on the road. They *have* acquired a not-

entirely-undeserved rep for ambushing unwary drivers, those foolish enough to lift their foot from the right pedal in the middle of a corner. It's called trailing-throttle oversteer, and it's caused by asking the rear wheels to slow down when they're already busy turning.

By hooking the fronts into the powertrain, they slow down too. Combined with new suspension geometry, the result is a car with phenomenal cornering, as befits a Porsche, and an ability to forgive even the most stupendously bad driving habits, something that hasn't always been true of 911 series cars. Throw in ABS, and the safety level is astounding.

One thing they haven't changed is Porsche's traditional high-speed competence. I managed 260 kph (160 mph) in only a short stretch of autobahn, and could have kept it up till the border.

—Mike Allen

## VW Corrado

Although it's increasingly difficult to stand out in the small sport coupe arena, Volkswagen's new Corrado gives every indication that it will do just that. Based on a modified Golf chassis and powered by a supercharged version of VW's solidly established 1.8-liter ohc Four, the Corrado is a highly appealing blend of good handling, superb high-speed stability, excellent ride quality and, to our eyes, distinctive good looks.

There's man-size room for front seat passengers (though rear seating is typical of plus-2 coupes), and the forward buckets are a step up from anything yet offered by Wolfsburg—which is saying something.



MAZDA MX-5 MIATA



## THE RITES OF SPRING

PHOTO BY JIM DUNNE



Control relationships are well coordinated, and steering response is first rate. About the only glitch we noticed in a 3-day high-speed tour of European freeways was balkiness in the new cable-operated 5-speed gearbox. VW insists this was merely a preproduction aberration that will be corrected by the time the car hits the U.S.

The supercharger is VW's unique scroll-type G-lader, pumping the 1.8's horsepower rating to 158 at 5600 rpm. That's enough to haul the Corrado to 60 mph in less than 8 seconds, with a top speed of 140, which is rarefied territory for cars in this class.

This can also be said for the project-  
(Please turn to page 134)

## Nissan's Infiniti Joins Luxury Car Wars

**F**EW AUTOMOBILE manufacturers ever have years as busy as the past 12 months at Nissan USA. Besides the outpouring of new Nissan-badged cars, some of which are described on these pages, the company is also getting ready to establish a second brand name and a national network of dealers to go with it.

As with the Honda Acura network and, more recently, Toyota's Lexus, Nissan's new division will be aimed squarely at the luxury-car market. When the first wave of Infiniti dealers—some 65 of them—opens for business in early November, the initial offering will consist of two cars, one selling in the \$30,000 range, the other in the \$20,000 bracket.

Because it was developed specifically for the U.S. market, the flagship Q45 sedan is the more significant of this twosome. Smooth and rounded in the Ford aero tradition, the Q45 will be comparable in size to a Lincoln Continental, with a wheelbase of 113.4 in. and an overall length of about 200 in. Coefficient of drag ( $C_d$ ) is expected to be 0.31, although Nissan engineers say the development emphasis was on airflow management as an element of vehicle dynamics—in particular, the car's stability at high speeds—rather than pure aero efficiency.

Although the sedan will weigh in at well over 3800 pounds, it's expected to be an impressive performer, thanks to a new aluminum alloy 4-cam 32-valve 4.5-liter V8 engine. Rated at 270 hp and 280 lb.-ft. of torque, the V8 is expected to send enough grunt through the car's electronically controlled 4-speed auto transmission and viscous limited-slip differential to produce 0-60 times in the rarefied region of 7 seconds.

Like Nissan's new 300ZX sports car,



the sedan will ride on an innovative all-independent multilink suspension system, with speed sensitive variable-assist power steering and 4-wheel disc brakes bolstered by an antilock system. Nissan also plans to make a 4-wheel-steering system available as an option. Considering its ample power and sporting suspension system, the Q45's tire contact patch is rather modest at 215/65VR15. Standard wheels are cast alloy, with forged alloys optional.

As prospective Q45 buyers can quite reasonably expect, the sedan's list of standard equipment will be long and sumptuous, including a 6-way power adjustable driver's seat, a 4-speaker Bose AM/FM/cassette sound system and power controls for just about everything imaginable.

On the outside, the Q45's sleek hide will be protected by a new paint process that includes a final coat impregnated with a Teflon-like fluorourethane compound designed to shed dust and soil buildup without waxing, something that should be welcome news to most luxury car owners.

The Infiniti M30 sport coupe presents a somewhat more familiar aspect than its larger stablemate. Al-

ready established in the Japanese domestic market as the Leopard, the M30 is about the size of a Chevy Camaro, including a curb weight in the region of 3300 pounds.

The convertible version, which should make its appearance shortly after the first of the year, will be about 200 pounds heavier.

The coupe will ride on a conventional suspension—MacPherson struts front, semitrailing arms rear, with anti-roll bars at both ends—although this thoroughly familiar arrangement will be augmented by Nissan's surface-sensing Sonar Suspension.

With a 165-hp sohc 3.0-liter V6 engine driving the rear wheels through a 4-speed automatic transmission, the M30's performance promises to be good but hardly breathtaking, given the car's weight, which, like its exterior dimensions, is also in the Camaro class. Braking performance, however, should be considerably better than good, with 4-wheel discs (vented front rotors, solid rears) and ABS as standard equipment.

Like the Q45, the M30's interior appointments will put plenty of emphasis on posh. Leather-clad upholstery is standard, as is a 4-speaker Bose sound system and a host of power-operated convenience equipment, including a 2-way sunroof. The optional convertible top will also be power-operated. On the safety side of the ledger, Nissan will augment the M30's 3-point front belt system with a driver's side airbag.

—Tony Swan







Besides transmitting facsimile documents through its built-in telephone with high resolution, Brother's FAX-60 (\$1895) serves as a photo copier and telephone answering device.

PM PHOTOS BY BRIAN KOSOFF

## THE FACTS ABOUT FAX

Telephone facsimile machines let you communicate without speaking.

BY FRANK VIZARD, Contributing Editor

**I**T USED to be that when you left work at the end of the day, you could safely assume that the job wouldn't follow you home. That's still true: Only now the work might be waiting for you when you arrive. What is blurring the line between your workplace and your home is the proliferation of telephone facsimile machines. Fax machines, as they are commonly called, are fast becoming the telecommunica-

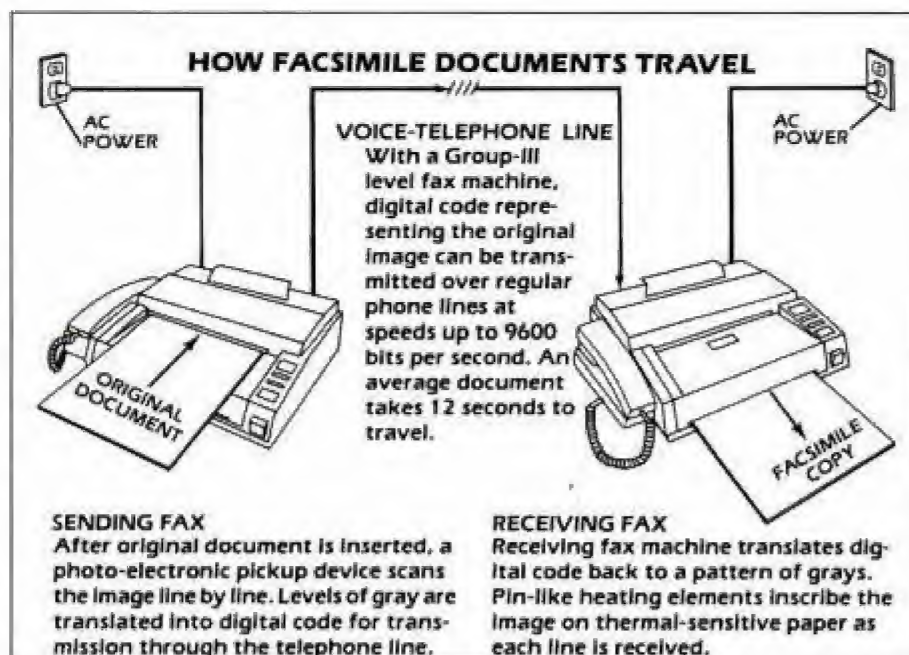


## FACTS ABOUT FAX

tions tool of choice. Nearly one million fax machines of all types were sold in 1988, double that of the year before. The fastest growing segment of the market is for machines priced under \$2000 and sized so that they fit unobtrusively on a desktop.

The rise of the low-priced fax machine is changing how Americans talk to each other. The transfer of documents has always been a part of business, and overnight mail was often the fastest delivery method available. With a fax machine, document transfers now take place in seconds. Moreover, inexpensive fax machines allow workers to receive information at home instead of having to wait at the office for a late communiqué from headquarters two time zones away. So while the line between the home and office is blurring, it's to the worker's advantage in many cases.

To date, fax machines have had their principle impact in the business world. But the arrival of basic models priced under \$1000 is having a broader impact outside of the office. Mom and Dad might have bought a fax machine for business use, but Junior has discovered that his favorite rock 'n' roll radio station is taking song requests by fax. Mom and Dad, meanwhile, have discovered that the local supermarket has a fax machine. All they have to do is fax their grocery list to the store and the goods will be waiting for them. No big deal. After all, they've been faxing their lunch requests to the delicatessen for quite a while.



### Choose a speed

Fax machines have been around for a long time. The bulky, spinning drum devices of yesteryear, however, have now been replaced by small machines that electronically scan a document, convert the information into a digital format for easy handling, and then transfer the data to a special modem for telephone transmission.

The best of this new technology is evident in Group III machines. Fax machines are classified into four groups according to how fast they transmit

data. Group III machines transmit data at a maximum rate of 9600 bits per second (also referred to as 9600 baud). A transmission rate of 9600 bps means that a typical page of data can be transmitted in about 12 seconds, under optimum conditions. Transmitting conditions, though, can be affected by things such as faulty or noisy telephone lines. Most fax machines do utilize some type of error correction circuitry in the event of a glitch. Practical transmission speed is in the range of up to 45 seconds per page, depending upon the machine and the transmission conditions.

Group III machines can fall back to communicate with slower Group II (2400 to 7200 bps) machines still in use. Group I machines dating from the early 1970s are effectively obsolete. Group IV machines transmit as fast as 3 seconds per page and are used by high-volume institutions with private digital telephone networks.

Within Group III, there is a wide range of models made by manufacturers including Brother, Canon, Cobra, Panasonic, Sharp, Toshiba, Ricoh and Murata. Prices vary according to the number of features and functions the machine offers. Not all of the features included in a machine have to do with fax transmission. The Brother FAX-60, for example, is a tiny, integrated communications device. Listing for \$1895, the FAX-60 also operates as a full-featured telephone, a personal copier and a tapeless telephone answerer capable of storing up to 112 seconds of messages.



The copier-style top-loading Sharp UX-80 (\$1499) lets you fax bound documents.





Contact-image scanning gives the Cobra PP-112 (\$999) its low profile. You supply the phone.

### How they work

From a technical standpoint, all fax machines operate in one of two ways. In many instances, the original document is fed into the machine where a charge-coupled device (CCD) image pickup, like those found in camcorders, scans the illuminated paper. The CCD imager, being relatively small, relies upon an array of mirrors that bounces the image into a lens where it can be read by the CCD.

The second method uses what's called contact image scanning (CIS). The original document passes through a strip of LEDs. The reflected light from the LED is captured by a fiberoptic link connected to electronic sensing circuits, which then convert the pixels into an electrical signal. Fax machines that use the CIS system tend to be a little more expensive than their CCD cousins.

Whatever the sensing system, a fax machine's electronic circuits convert the pixels—the light and dark picture elements—into an electrical signal that represents the various shades of gray in the original document. Fax machines are often rated according to the number of different shades of gray the machine can transmit. A machine capable of transmitting as many as 64 shades of gray will reproduce better representations of photographs and other graphic material than a machine capable of transmitting only eight.

From an operating standpoint, however, there are few differences among fax machines. In most instances, the original document is inserted through the scanning device for transmission. Data to be received is printed onto thermal paper stored on a roll inside the ma-

chine. The paper exits the machine as the data is received. Printing is actually done by a stylus that tracks or burns an image onto the paper. Standard roll size is 328 ft. and costs between \$4 and \$5.

One operating variation, however, is illustrated by Sharp's UX-80 fax machine. The UX-80 (\$1499) operates much like a copier. The original document is placed flat atop a clear plate for scanning. This makes the UX-80 well-suited for transmission from 3-dimensional objects such as books or other bound documents.

### Features and functions

Most differences among machines are in terms of features. Many fax machines come with a built-in telephone—even inexpensive models such as Murata's M1200 (\$900). If you have a spare phone, you might opt for a stand-alone machine such as Cobra's PP-112 (\$999). As you can see, the absence or inclusion of a phone with the fax machine has little effect on price.

More fundamental to price are fax

transmitting features. The Murata M1200, designed for the person making five to 10 fax transmissions per day, keeps features to a minimum to keep the price low. The M1200 offers:

- Automatic record keeping to monitor every transmission and reception.
- CCD scanning of documents up to 10.1 in. wide. The printer reduces incoming data to 8.5 in. in width.
- Automatic or manual reception modes so that the machine can function strictly as a telephone.
- Polling, in which the fax machine is programmed to call another location and receive documents automatically.

The Cobra PP-112, for the sake of comparison, uses CIS scanning and offers a VOICE ALERT button so you can signal the other fax operator that you would like to continue the conversation after the fax transmission is complete. Normally, the connection is broken after a fax transmission.

The more features it has, the more costly a fax machine is likely to be. Alternate features often included in fax machines are:

- Alternate dial, to send messages to a second location if the first number cannot be reached.
- Automatic redial, if the desired number is busy.
- An automatic paper cutter so that received transmissions do not appear as just one long piece of paper.
- Delayed transmission capability, to save money by transmitting at off-peak rates.
- Sequential polling so that a document can be sent to several locations either at once or at a later time.
- Confidentiality, so that a fax machine will not receive transmissions unless the correct password is entered. This cuts down on junk fax.

Fax machines are definitely here to stay. Prices should creep downward as time goes on. Lower prices will prompt even more people to become fax machine owners. So don't be surprised if your friends start passing on their fax numbers to you soon.

PM



Murata's M-1200 (\$900) is a basic fax with built-in phone and few other frills. It's designed for low-volume applications.



BOATS

# PACKAGE DEALS

Fully loaded family boats for \$10,000 or less meet in a 6-way battle of the budget.

BY JOE SKORUPA, Boating/Outdoors Editor; PM Photos by Skip Gandy



WELLCRAFT 170 SPORT



**T**HERE was only one rule. Each boat was to be priced at \$10,000 or less. After that, it was head-to-head, no-holds-barred PM-style competition, or in this case econo combat.

The test fleet ranged in size from 15 ft. to 19 ft. Power went from 48-hp outboards to 130-hp sterndrives. Yet, despite the diversity, the boats had one thing in common: All were boat-motor-trailer packages, which meant they were integrated and engineered at the manufacturer.

Wisconsin's lovely Lake Geneva served as our test base and we ran the boats hard for three days. Data was collected with tape measure, radar gun and stopwatch, including a performance-course time based on full-speed runs on a quarter-mile, figure-eight loop. We didn't rank the boats, because of their dissimilarity, but four boats clearly distinguished them-

selves in terms of performance, design and overall workmanship. Here are the test results.

### **Larson All American**

If the Larson All American DC-170 was merely the driver's favorite (first-place finishes in acceleration and performance-course times and second in top-end speed), it would easily vie for best-in-fleet honors. But since it was also the most consistent overall finisher and voted best dressed by the test team, it practically walked away with the title.

This doesn't mean the Larson is perfect. Some nits to pick are cramped legroom for tall drivers, uncarpeted stowage areas, and a non-standardized trailer supplied on the dealer end of the sale.

But these are minor. More importantly, full-deck carpeting and vinyl padding keep bare fiberglass to a minimum. Flowing body lines are enhanced by integrated swim platform and bow rails, cleats and fuel fill. The radio/cassette is hidden in a lockable glovebox and the stout engine cover keeps the roar of the 130-hp Merc

sterndrive to a minimum. The All American is a name reintroduced to the Larson line this year. Many boat-ers will be glad it's back.

### **Bayliner 1900 Capri**

Giving the Larson a run for top honors was the Bayliner 1900 Capri. It scored well in driving categories (second in acceleration and performance-course times and fourth in top-end speed), overall consistency, and fit and finish. And this for \$200 less than the Larson sticker price.

In addition, the Capri ranked first in usable deck area, and first in stowage space. Other features of note are plenty of legroom behind the side consoles, full-deck carpeting and padding to eliminate exposed fiberglass, recessed bow rails and cleats, rounded transom corners and well-placed entry/egress pads.



**LARSON ALL AMERICAN DC-170**



**CHRIS-CRAFT CAVALIER 17**



## PACKAGE DEALS

Naturally, there were some shortcomings, such as an uncarpeted ski locker that runs all the way to the bow where items can jostle out of reach. Others include uncarpeted bow stowage compartments, shaky windscreen angled perilously close to driver's head, and a canvas top without hidden stowage compartment.

Still, the Capri is a top-performing boat and a solid value, which is what the package-boat trend is all about.

### Sunbird SPL 150

Big things sometimes come in small packages. The 15-ft. Sunbird was the fleet's smallest boat, which accounts for last-place rankings in usable deck area and stowage space. It also came equipped with the smallest powerplant (48-hp Evinrude SPL), which turned in back-of-pack radar gun and timing runs. But it was the clear leader in an important category—price, which was \$5999. It was also a sporty boat with flowing lines and colorful hull graphics and upholstery.

Despite its lack of power, the Sunbird hit 30.58 mph, fast enough for waterskiing, and handled smoothly enough to beat two more powerful boats on the performance course.

To a certain extent, however, you get what you pay for. Some of the

problems we noted were flexing side windcreens, shaky console seats with cramped kneeroom, minuscule stowage space, a wet ride in whitecaps, and a poorly secured gas tank.

On the other hand, the interior had no exposed fiberglass, the ski locker and stowage compartments were carpeted and, like the higher priced boats, it came with radio/cassette, swim step, boarding ladder, canvas top (which stores upright) and many other package-boat features.

### Chris-Craft Cavalier 17

Despite middle-of-the-pack rankings across the board, the Cavalier was a winner in value because it was solid in the most important area of all—fundamentals, which includes handling, fit and finish and sporty good looks.

It was surprising to the test team that the boat equipped with a 130-hp OMC Cobra sterndrive (tied for largest engine with Larson) was fourth in hole shot and third in top-end speed and on the performance course. Perhaps this was due to a large prop, although rpm was normal.

Features of special note include hidden stowage for canvas top, recessed bow rails, carpeted ski locker and stowage compartments, removable cooler and the most complete

array of dash-mounted gauges and instruments in the fleet.

Problem areas were knee-banging consoles, unpredictable Forward-Neutral-Reverse transmission shifter, and a carpet section in the bow that was snap-riveted, seemingly a quick half-measure solution.

### Wellcraft 170 Sport

As a boatmaker scoring big in high-performance boats and large cruisers, it's not surprising that Wellcraft isn't focused on low-end packages. This may explain why the 170 Sport package was so spartan in appearance and disappointing in performance.

Fit-and-finish problems we noted were bare fiberglass in bow and on console, exposed screws on console supports in the deck, oversized vinyl pads that stuck out into the walk-through area, and exposed wiring for throttle and dash instruments.

On the performance course, we found unusually stiff torque in the steering and severe cavitation in turns. Also, the boat had a tendency to dig a chine and hook sharply if the driver wasn't careful.

Although the 170 Sport had back-of-pack rankings, it represents an initial Wellcraft effort in the low-end package-boat market.



1. BASS TRACKER 1800TF	2. BAYLINER 1900 CAPRI	3. CHRIS-CRAFT CAVALIER 17
LOA: 18' Beam: 86" Wt.: 1386 lb./Fuel: 27 gal.	LOA: 18'11" Beam: 88" Wt.: 1905 lb./Fuel: 31 gal.	LOA: 16'11" Beam: 85" Wt.: 2200 lb./Fuel: 21 gal.
Usable Deck Area: 70.66 sq. ft./Ranking: 3	Usable Deck Area: 80.70 sq. ft./Ranking: 1	Usable Deck Area: 70.50 sq. ft./Ranking: 4
Stowage: 34.35 cu. ft., huge livewell/Ranking: 2	Stowage: 36.99 cu. ft., copious/Ranking: 1	Stowage: 17.55 cu. ft., acceptable/Ranking: 5
Top End: 46.0 mph/Ranking: 1	Top End: 38.25 mph/Ranking: 4	Top End: 38.50 mph/Ranking: 3
Hole Shot 0-25 mph: 8.70 sec./Ranking: 6	Hole Shot 0-25 mph: 6.53 sec./Ranking: 2	Hole Shot 0-25 mph: 7.75 sec./Ranking: 4
Performance Course: 37.02 sec./Ranking: 6	Performance Course: 25.29 sec./Ranking: 2	Performance Course: 26.75 sec./Ranking: 3
Fit & Finish: Spartan but sufficient for fishing	Fit & Finish: Good workmanship, nice touches	Fit & Finish: Superior, few glitches
Decibel Reading: 88 dB idle, 114 dB full throttle	Decibel Reading: 68 dB idle, 93 dB full throttle	Decibel Reading: 68 dB idle, 92 dB full throttle
Trailer: Among best with center roller, long bunks	Trailer: No jack, but light enough to lift	Trailer: Superb center roller, winch, safety chain
Price As Tested: \$9999*	Price As Tested: \$9795*	Price As Tested: \$9854*
Address: Tracker Marine, 1915-C S. Campbell, Springfield, MO 65807, (800) BASS PRO	Address: Bayliner Marine, P.O. Box 24467, Seattle, WA 98124, (206) 435-5571	Address: Chris-Craft, P.O. Box 9450, Bradenton, FL 34206, (813) 747-4100
Ideal high-mounted gauges, 3-position wheel, compass and flasher. 	Minimal instrumentation but superior visibility and legroom. 	Most complete instrumentation but knees bang low and cramped console. 

\* Manufacturer's price at time of PM test, Sept. '88





Ready to go on land and water are (clockwise beginning with top boat on trailer): Chris-Craft Cavalier 17, Bass Tracker 1800TF, Bayliner 1900 Capri, Larson All-American DC-170, Sunbird SPL 150 and Wellcraft 170 Sport.

## Bass Tracker 1800TF

In many respects, you get more bang for your buck with the big 18-ft. Bass Tracker than with any boat in the fleet. It comes with a lighted compass, in-dash flasher, three batteries, bow-mounted trolling motor, two casting seats and sparkling metal-flake finish.

Nevertheless, this low-to-the-wa-

ter boat gave a wet-and-wild ride in a chop and showed signs of serious bow-to-aft hull flexing. Cavitation problems were severe and frustrated the best efforts to correct them by the test team and an OMC technician.

On the plus side, the flat-bottomed boat was the fleet leader in top-end speed and scored well in stowage and deck space, important for fishermen.

Despite the noted glitches, the Bass Tracker and the rest of the fleet represent the dawning of a new era in entry-level boats. With these and other all-in-one boats the listed price is the final price. No hidden costs. What you see is what you get, and what you get is a boat ready to go and loaded with features that were once considered extras.

PM



### 4. LARSON ALL AMERICAN DC-170

LOA: 17'/Beam: 88"/Wt.: 2091 lb./Fuel: 20 gal.

Usable Deck Area: 72.45 sq. ft./Ranking: 2

Stowage: 20.27 cu. ft., sufficient/Ranking: 4

Top End: 40.42 mph/Ranking: 2

Hole Shot 0-25 mph: 5.89 sec./Ranking: 1

Performance Course: 25.22 sec./Ranking: 1

Fit & Finish: Headturning, voted best dressed

Decibel Reading: 67 dB idle, 92 dB full throttle

Trailer: Only nonstandardized unit in fleet

Price As Tested: \$9995\*

Address: Larson Boats, W. Mississippi River Dr., Little Falls, MN 56345, (612) 632-5481

### 5. SUNBIRD SPL 150

LOA: 15'2"/Beam: 73"/WL: 1250 lb./Fuel: 12 gal.

Usable Deck Area: 50.22 sq. ft./Ranking: 6

Stowage: 9.35 cu. ft., minimal/Ranking: 6

Top End: 30.58 mph/Ranking: 6

Hole Shot 0-25 mph: 8.21 sec./Ranking: 5

Performance Course: 27.04 sec./Ranking: 4

Fit & Finish: Minor glitches, but major value

Decibel Reading: 64 dB idle, 90 dB full throttle

Trailer: Nonwelded unit, but has center roller

Price As Tested: \$5999\*

Address: Sunbird Boats, 2348 Shop Rd., Columbia, SC 29201, (803) 799-1125

### 6. WELLCRAFT 170 SPORT

LOA: 16'9"/Beam: 87"/WL: 1650 lb./Fuel: 20 gal.

Usable Deck Area: 67.04 sq. ft./Ranking: 5

Stowage: 20.69 cu. ft., adequate/Ranking: 3

Top End: 32.50 mph/Ranking: 5

Hole Shot 0-25 mph: 7.49 sec./Ranking: 3

Performance Course: 27.42 sec./Ranking: 5

Fit & Finish: Rough edges even at price

Decibel Reading: 68 dB idle, 90 dB full throttle

Trailer: Bunk trailer painted to match boat

Price As Tested: \$8995\*

Address: Wellcraft Marine, 7150 Bradenton Rd., Sarasota, FL 34243, (813) 753-7811

Excellent forward visibility due to high windscreen, slight obstruction of gauges.



Top of windscreen cuts into line of sight, superb visibility of instruments.



Good throttle position and visibility of gauges, but wiring exposed.





## PROJECT CAR



# BEARBAITER

A meaner, tougher, more powerful look for Chevy's hot Beretta coupe.

TEXT AND PHOTOS BY CLIFF GROMER

**T**HERE'S no doubt Chevrolet has a hit on its hands with the Beretta. The car's distinctive styling sets it apart from the pack, and it's become the division's most popular seller. The trouble is, there's not much to set it apart from other Berettas. So you constantly see yourself coming and going. Even the GT model of the car is a common sight.

One solution to this identity crisis is to personalize the Beretta and give it a unique look, with more of a performance image. Helping us finalize the look of the car, as well as fabricating the add-on pieces, was Bill Kolb of Spoilers Plus in Blauvelt, New York, who manufactures bolt-on body pieces for several of today's sporty cars including the Mustang and T-Bird.

Our starting point was an '87 Beretta CL which we planned to turn into our own GT version. The first step was to determine what the car needed for a more aggressive, macho look.

We felt the front looked too thin and needed a more massive appearance. The sides of the car were too pinched in at the bottom for the look we wanted, and there wasn't enough visual weight in the body to counterbalance the glass area. Just about every sporty car

today comes with a rear wing, so we also penciled in this addition to our body package.

Spoilers Plus fabricated a number of full-size clay models that were fitted to the car for evaluation and final adjustments. Fiberglass molds were then made from the clay mockups.

We used fuel injection emblems from a '65 Corvette to recapture some of the flavor of the muscle age.

The Beretta's stock eggcrate grille didn't look hairy enough for our taste, so we came up with a replacement of our own design with a more racy, straight-bar look. The front air dam was styled to complement the grille, with openings for small fog lights. It also brings out the bottom of the car for more visual weight without sacrificing any ground clearance.

The sides of the stock Beretta bothered us the most as they were pinched in below the beltline. We wanted to bring out the lower portion of the sides about 3½ in. so the area would be even with the midpoint of the car. To avoid a too-massive look, we styled the area with Ferrari Testarossa-inspired fins. Because of the intricate detail work these side grilles required, the mockup to make the molds for the fiberglass pieces was fabricat-





ed from wood rather than clay. The side treatment consists of three separate pieces—the ribbed side spats which attach to the rear of the front fender and flow into the replacement rocker panel, which extends out 3 in. more than stock, and the rear-quarter deflectors. The main ribbed side panel attaches directly to the lower part of the stock door skin.

The rear-quarter deflectors attach to the bumper and bring out the width at the rear so it appears even with the front side spats. It all makes for smooth flowing lines and gives the entire side a correct proportion. The deflectors also prevent dirt and stones from chipping the paint.

We didn't want to go too wild on the rear wing. We liked the top of the decklid just the way Chevrolet did it and we wanted to more or less mirror the existing lines.

Wheels and tires were the final touch, and making an improvement here is as simple as a trip to the Chevy order book. We opted for the Beretta GTU's 16 × 7-in. wheels and the fat 205/55VR16 Goodyear Eagles.

The total effect of this relatively modest restyling is a whole new personality for the Beretta with the hairiest muscle image this side of the '60s.

**PM**

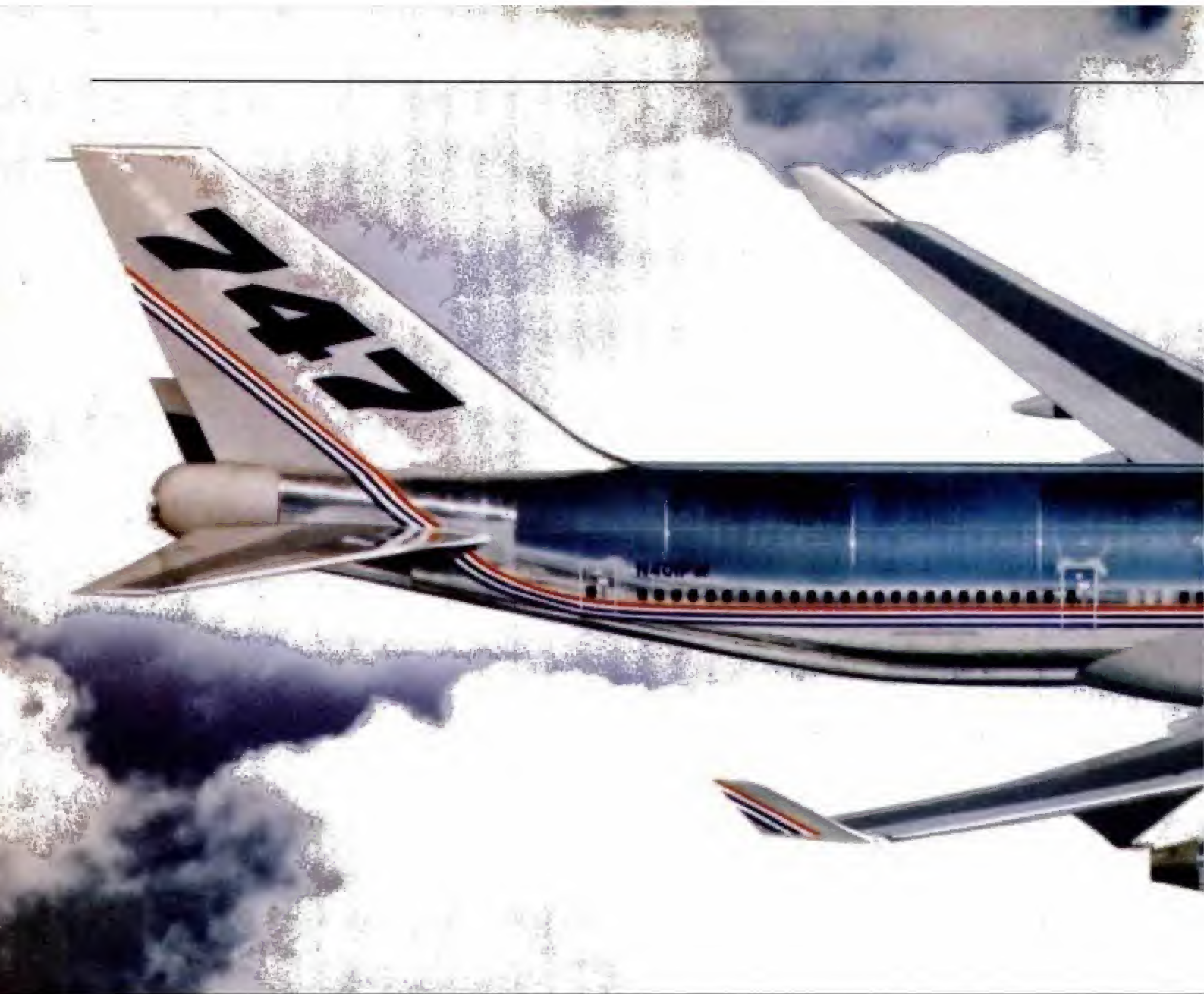


PHOTO BY BILLY BUCKMAN

## TRANSFORMING THE BERETTA

Bolt-on body pieces give this popular Chevrolet a whole new look. Molded-on hood scoop resembles Chevy's old cowl induction high performance hoods. Front air dam helps create a more aggressive front end appearance. Fuel injection emblems add image. Ribbed side panels add width without bulk. Ribs are similar to those used on Ferrari Testarossa and route cooling air to the rear brakes. Low profile rear air spoiler adds minimal height to deck.





**O**NE HUNDRED different 747s from all over the world are at New York's John F. Kennedy Airport this sparkling clear January day, but two are special. The first, with tail number N633US, is cleared onto Kennedy's longest 14,000-ft. runway. "Northwest 17, runway 31 Left, position and hold."

The pilot nudges the throttles forward, breaking the inertia of this giant weighing nearly 900,000 pounds. The aircraft carries 250,000 pounds of fuel, a full load of 402 passengers, and a belly full of baggage and freight. It creeps forward the first few feet on a journey that will cover 6300 miles and end in Tokyo, Japan, 14 hours later.

This regular daily Northwest flight will also go down in history as the first revenue movement of Boeing's latest cruise ship of the sky, the 747-400.

The second special 747 to visit JFK this morning, N733, is 10 miles south-

east of the airport, 3000 ft. over the chilly Atlantic. Pan American Flight 101 from London is cleared for the approach to runway 31 Right. This 747-100, with *Clipper Pride of the Sea* emblazoned on the front of its shiny fuselage, is remarkable in its own right. It is the first 747, of the roughly 700 now in service, to be delivered to an airline. In fact, this January 1989 landing is N733's 17,000th since Pan American began operating the airplane in January, 1970.

The 747-400 bears a strong family resemblance to the pioneer 747. But from its vastly changed avionics to the very alloys it is made of, the 747-400 is a bird of a different feather. It offers more range, better fuel economy and lower operating costs than any previous 747. Its 8400-mile range almost doubles that of the original 747, and it consumes almost a third less fuel per seat. Its engines produce a fifth more power than the original, and the 400 carries more passengers and freight.

Comparing the first 747 with the newest version also provides an intriguing glimpse of aviation past and aviation future—a chance to closely analyze almost two decades of progress in the air.

### Prepared for takeoff

As the Northwest captain turns the airplane to line up with 31 Left, he looks back over his shoulder 200 ft. to check clearance and sees the wingtip with its distinctive 6-ft.-high winglet sweeping the horizon. The winglet is a major element in the 400's load and range improvements. To carry the additional weight over the extended range, more lift was needed and this was accomplished by adding 6 ft. to the span of each wing.

That was about all the wings could be stretched, however, without causing operational problems at the airports the 747 flies into. Hangars, docking spaces and even runways are only so wide.



# BIG BIRD

Commercial air transport takes a giant leap forward as the 747-400, with almost 1 million pounds of lift capacity, goes into service.

BY FRED MACKERODT, Contributing Editor



The winglets, jutting up an additional 6 ft. at a 29° angle from the wings, provide the additional lift without causing clearance problems. They also enhance the airplane's aerodynamics by cleaning up the wing-tip vortices, those tornadoes of air that come off the ends of all wings when they're producing lift.

In extending the wings, Boeing engineers were confronted with a problem. They knew that each 1-percent increase in weight causes a 2-percent reduction in range. By building the wings with new aluminum alloys used in the 757 and 767, and constructing the winglets out of graphite-epoxy material, they were able to save 5000 pounds, completely offsetting the weight which would have been required for the modification. The winglets provide a fuel burn improvement of about 3 percent. The 400 spans 211 ft. from wingtip to wingtip—gaining an additional 2 ft. when it is loaded with fuel.



The most significant improvement of the Boeing 747-400 can be found in the plane's "glass" cockpit, a futuristic sanctuary of multihued cathode-ray tubes. Reduced workload means that two pilots can operate the aircraft, eliminating the flight engineer's position. The key: Microprocessors have reduced the number of switches, gauges and indicator lights from 971 to 365. Computers control most of the 747-400's flight, including the landing. But they also help pilots monitor aircraft systems, enhancing safety by allowing flight crews to keep an eye on traffic.



## BIG BIRD

### In the cockpit

Pan Am 101 intercepts the glide-slope for Runway 31 Right and the first officer extends the landing gear to begin the descent. The 747 was designed with 16 separate wheels on its four main landing gear to distribute its weight over a larger area. The big planes exert less of a load on a runway than a lot of much smaller airplanes.

As with all 747s prior to the 400, a 3-man crew—two pilots and an engineer sitting sidesaddle—monitors the approach of Pan Am 101 to Kennedy. They scan control panels containing nearly 1000 conventional gauges, switches and lights.

While it has undergone a tremendous amount of upgrading in the 74,000 hours it has been flying, N733 was born at a time when the pocket calculator was high tech and personal computers were only a far-off dream. Charles Lindbergh would feel at home in the cockpit of N733, with its familiar round gauges.

But the cockpit of N633US is something else entirely. It is a second-generation glass cockpit. Its ambience is that of a videogame parlor, rather than an airplane. The two pilots get the majority of the information they need from six colorful 8x8 cathode-ray tubes. The 971 lights, switches and gauges in the original 747 cockpit have been reduced to 365 in the 400—less than in much smaller airplanes like the 737 and the DC-9. In fact, the engineer's control panel has vanished entirely along with the engineer. The 747 has a 2-man cockpit crew. Pilots in modern airliners are there more and more to monitor the performance of the airplane than to fly it. Where the original 747 had three on-board computers, the 400 has 150 microprocessors.



Revised wing geometry means nonstop flight from Los Angeles to most points in the Pacific rim and Europe.

### Short final

*Clipper Pride of the Sea* continues to slide down Kennedy's 3° glide-slope. With gear extended and flaps at 30°, its nose is high, creating a sight common near most large airports. To the observer on the ground, it looks as if it is hanging in midair. Its speed is 140 knots, a point where a lot of jet aircraft begin to get squirrely, but its handling is rock solid. Over the fence and just prior to touchdown, the speed of N733, which, at 400,000 pounds, is considerably lighter after its transoceanic journey from England, will decrease to 118 knots. The stable slow-flight characteristic, in fact, makes the 747 the safest commercial airliner to ever fly. Most accidents occur during the takeoff and landing phases of flight, and it is in this regime of flight that the 747 excels. Another factor that makes the 747 safe is the triple and quadruple redundancy of its systems. Complete failure of any one system in the 747 is a

million-to-one possibility. In 20 million hours of flight over 10 billion miles, the 747 has carried 700 million passengers in complete safety. That is to say that while 747s have been lost to human error and human intervention of more hostile sorts, no 747 has ever crashed due to a mechanical failure. (The only possible exception is the South African Airways flight which went down in the Indian Ocean after a suspicious fire.)

The 747-400 will in all likelihood continue the aircraft's superb safety record. The newest airplane is even more stable at slow speeds, due to the winglets and revised wing geometry, and systems redundancy has been increased.

### Into a new age

Northwest 17 is cleared for takeoff, and the captain advances the four shiny new throttles. The Pratt & Whitney 4056 engines spool up and slowly begin to propel this, the heaviest aircraft ever to take off in commercial revenue operation, down the runway. Passengers and crew feel that familiar pressure in the seats of their pants as the G forces build. The high-bypass engines powering N633US reside in redesigned nacelles and deliver 56,750 pounds of thrust, 20 percent more than the 747s' original P&W JT9D's, and are vastly more efficient. (Later 400s will also be delivered with General Electric and Rolls-Royce engines rated at 58,000 pounds of thrust. All engines and nacelles are interchangeable with those of the widebody 767.)

At a predetermined speed, governed by weight, temperature and other factors, Northwest 17's copilot utters the first word

## The Tragedy Of Flight 103

**A**S THIS ISSUE went to press, a bomb located in the forward cargo hold of Pan Am Flight 103 was declared the cause of last December's Scottish air disaster involving the 15th 747 ever constructed.

Thus, one of the most catastrophic air crashes in history became a murder mystery combining standard investigation procedures and forensic science.

Ted Lopatkiewicz of the National Transportation Safety Board told PM that crash investigators customarily divide into teams to study a downed airplane's structure, systems, maintenance and flight crew history.

The keys to any accident investigation are cockpit voice and flight data recorders

using Mylar-backed magnetic tape. They are located in steel, crash-resistant boxes near the tail of the aircraft.

The continuous tapes record cockpit conversations and radio transmissions up to 30 minutes before a crash. The flight data recorder monitors altitude, air speed, flaps/slats position, aircraft attitude and engine performance. Both of Flight 103's recording devices ended abruptly.

But bomb theories were given additional credence when British explosives experts found telltale signs of heat damage on a Kevlar lining in the forward cargo bay.

Two techniques are normally used to

detect microscopic residue of explosive materials: chromatography, which detects chemicals by their molecular differentiation; and mass spectrometry, when ionized particles of a foreign substance are analyzed against ions of known materials.

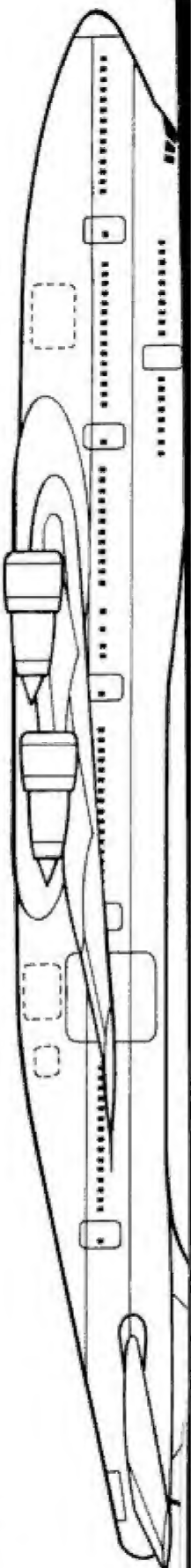
Experts at the scene said Semtex, a Czechoslovakian-made plastic explosive, was the most likely material used to destroy the airliner. This type of explosive can be easily molded into a piece of luggage for concealment.

What can't be concealed, however, is the brutal result of terrorism—the 20th century scourge that shows no sign of abating.

—Tim Cole



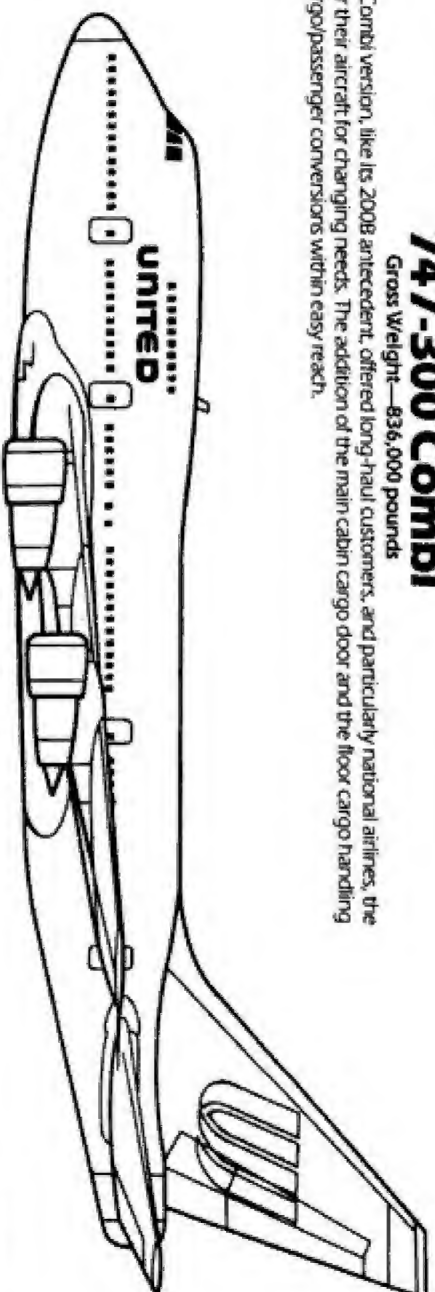




## 747-300 Combi

Gross Weight—836,000 pounds

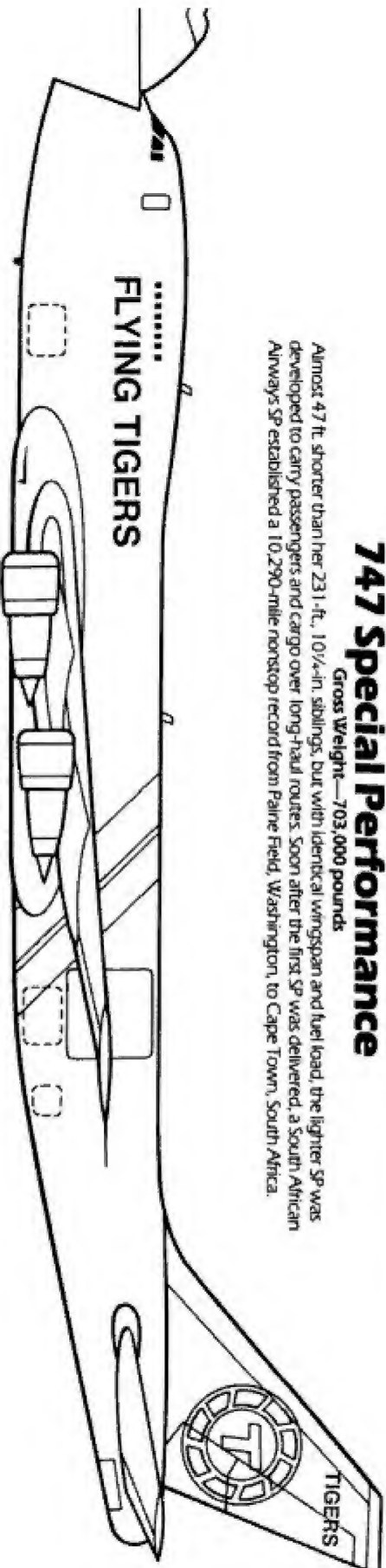
The 747-300 Combi version, like its 200B antecedent, offered long-haul customers, and particularly national airlines, the chance to alter their aircraft for changing needs. The addition of the main cabin cargo door and the floor cargo handling system put cargo/passenger conversions within easy reach.



## 747 Special Performance

Gross Weight—703,000 pounds

Almost 47 ft. shorter than her 231-ft., 10¼-in. siblings, but with identical wingspan and fuel load, the lighter SP was developed to carry passengers and cargo over long-haul routes. Soon after the first SP was delivered, a South African Airways SP established a 10,290-mile nonstop record from Palme Field, Washington, to Cape Town, South Africa.



## 747 Freighter

Gross Weight—836,000 pounds

Dedicated cargo operators like Flying Tigers and United Parcel Service have relied on the freighter version of the jumbo jet since the aircraft's first revenue mile April 19, 1972. Chief advantage of the 747F, like its convertible cousin, is the significant ease in cargo handling.

# 747 Jumbos

PM ILLUSTRATIONS BY JOHN BATCHELOR

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REST BUNKS

2-PILOT  
FLIGHT DECK

FIRST CLASS CABIN  
134 SEATS

RADOME—WEATHER,  
RADAR, LOCALIZER AND  
GLIDE-SLOPE AERIAL

NOSE-WHEEL  
UNDERCARRIAGE BAY

FORWARD  
HOLD

LOWER  
GALLEY

STAIRS TO  
UPPER DECK

WATER  
TANKS

MAIN FUEL TANK

AIR CONDITIONING  
DUCTS

OVERHEAD PANEL:  
ENGINE START  
ELECTRICAL SYSTEM,  
HYDRAULIC SYSTEM,  
OXYGEN SYSTEM,  
FUEL SYSTEM,  
FIRE CONTROL,  
INERTIAL NAVIGATION  
SYSTEM MODE SELECT,  
TEMPERATURE CONTROL

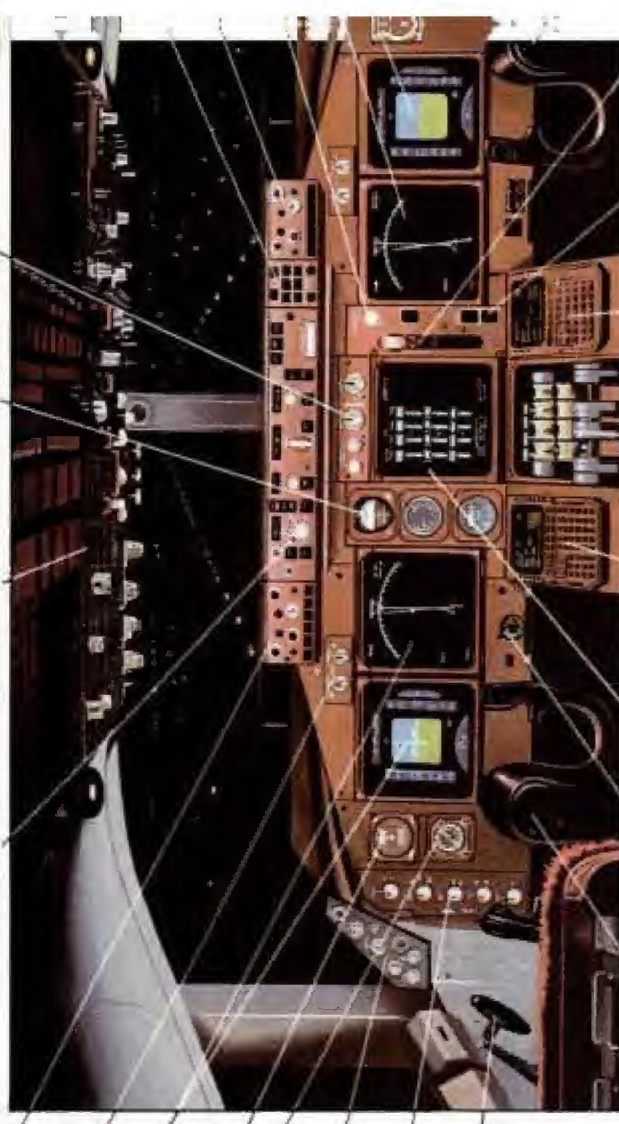
AUTOPILOT/  
FLIGHT DIRECTOR  
SYSTEM MODE  
CONTROL PANEL

STAND-BY  
INSTRUMENTS

FIRST-STAGE  
COMPRESSOR

MAIN GEAR

EICAS  
CONTROL  
PANEL



EFIS  
CONTROL  
PANEL

DISPLAY  
SWITCHING

ELECTRONIC  
FLIGHT INSTRUMENT  
SYSTEM (EFIS)

REAL-TIME CLOCK

RADIO-MAGNETIC  
INDICATOR

INTERNAL  
LIGHTING CONTROLS

INSTRUMENT  
SOURCE SELECTION

NOSE-WHEEL  
STEERING TILLER

CAPTAIN'S  
CONTROL  
COLUMN

BRAKE  
PRESSURE  
INDICATOR

ELECTRONIC  
FLIGHT  
INSTRUMENT  
SYSTEM (EFIS)

MAINTENANCE  
CONTROL  
DISPLAY UNIT

ENGINE  
CONTROLS

MAINTENANCE  
CONTROL  
DISPLAY UNIT

ALTERNATE  
GEAR  
CONTROLS

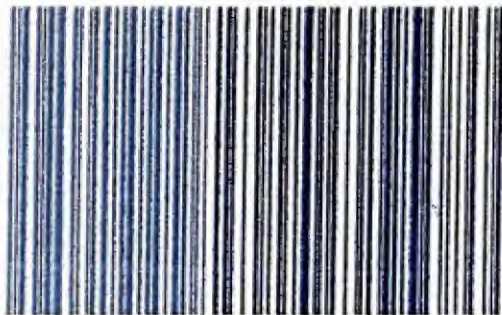
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Back

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Inverted Back

1. Follow instructions on the other side



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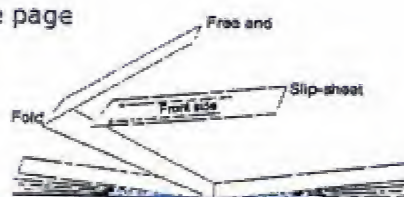
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4. Close the page and slip-sheet



Inverted Foldout slip-sheet

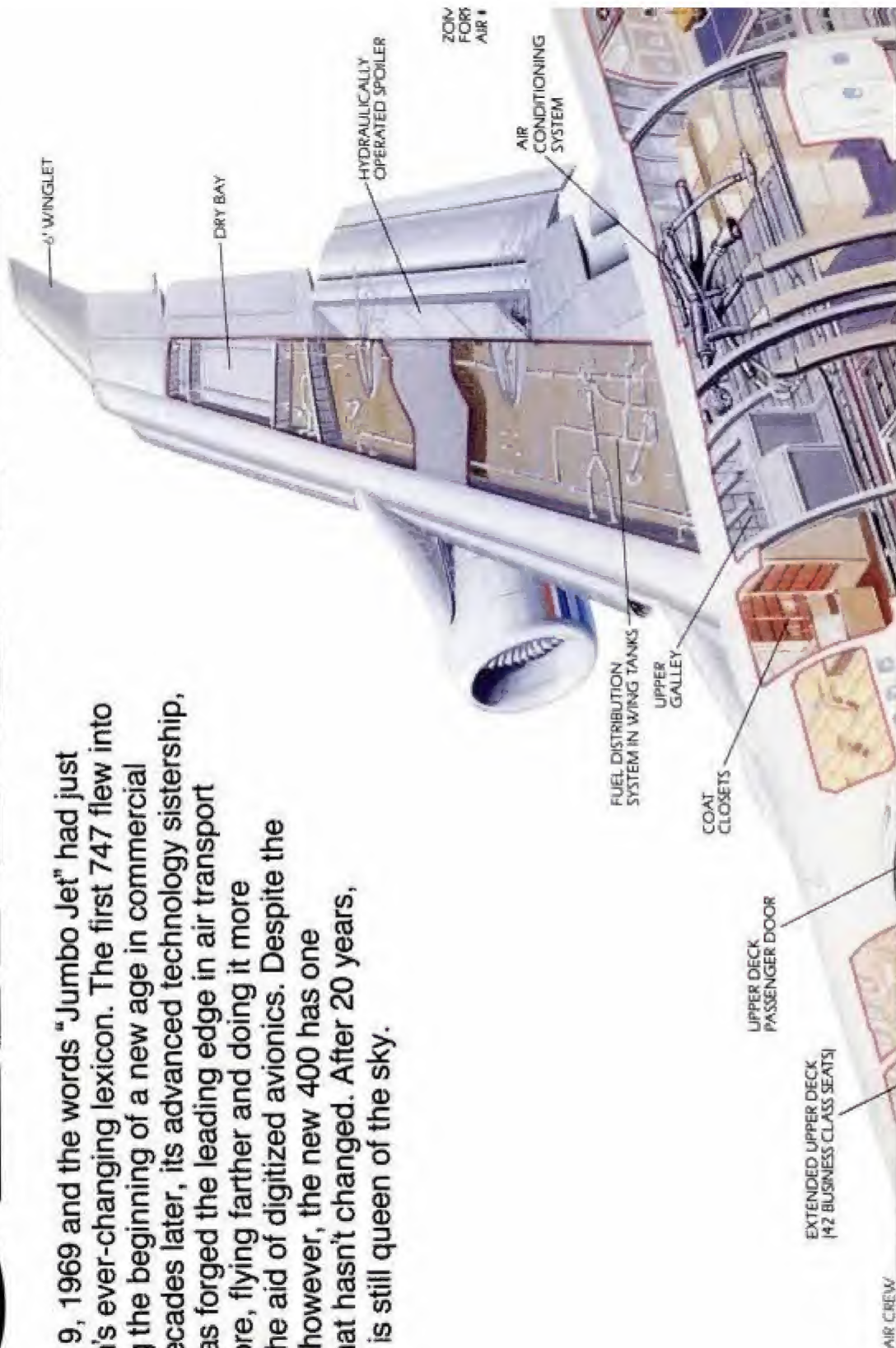
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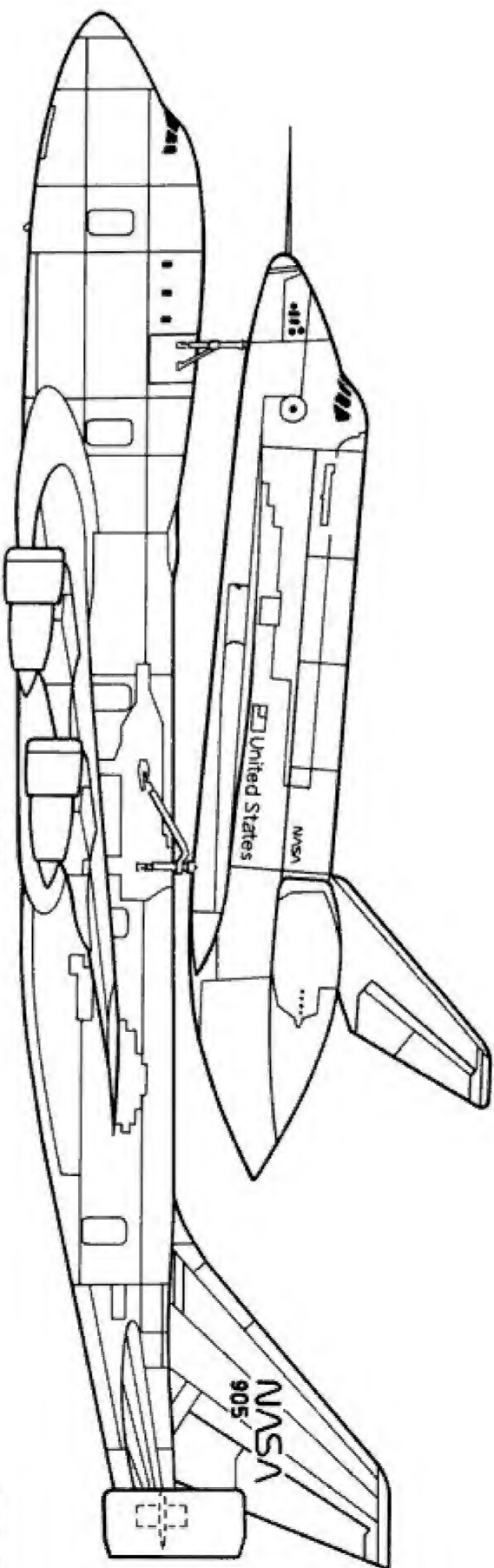


# BOEING 747-

It was February 9, 1969 and the words "Jumbo Jet" had just entered aviation's ever-changing lexicon. The first 747 flew into history, marking the beginning of a new age in commercial aviation. Two decades later, its advanced technology sistership, the 747-400, has forged the leading edge in air transport tech — lifting more, flying farther and doing it more efficiently with the aid of digitized avionics. Despite the improvements, however, the new 400 has one characteristic that hasn't changed. After 20 years, the Boeing 747 is still queen of the sky.



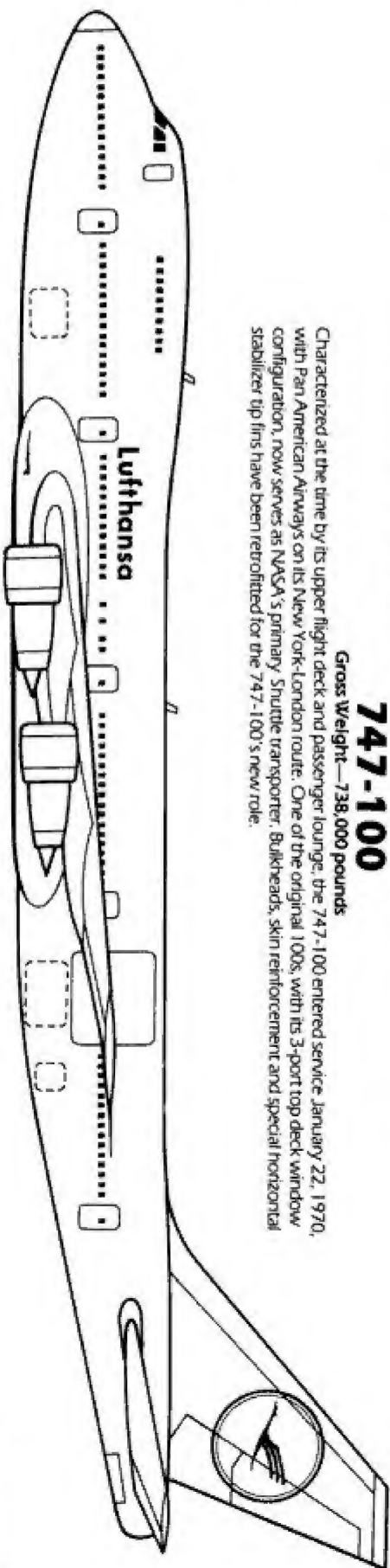




## 747-100

Gross Weight—738,000 pounds

Characterized at the time by its upper flight deck and passenger lounge, the 747-100 entered service January 22, 1970, with Pan American Airways on its New York-London route. One of the original 100s, with its 3-port top deck window configuration, now serves as NASA's primary Shuttle transporter. Bulkheads, skin reinforcement and special horizontal stabilizer tip fins have been retrofitted for the 747-100's new role.



## 747-200B Combi

Gross Weight—836,000 pounds

Customer demand for greater versatility sparked the design changes that resulted in the 747-200B Combi. The installation of a huge cargo door on the port side of the main cabin meant the aircraft could be easily changed from passenger mode to freight hauler. A cargo handling system with floor rollers was designed to accept the 747's enclosed cargo pallets.





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Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





1. Follow instructions on the other side

Back

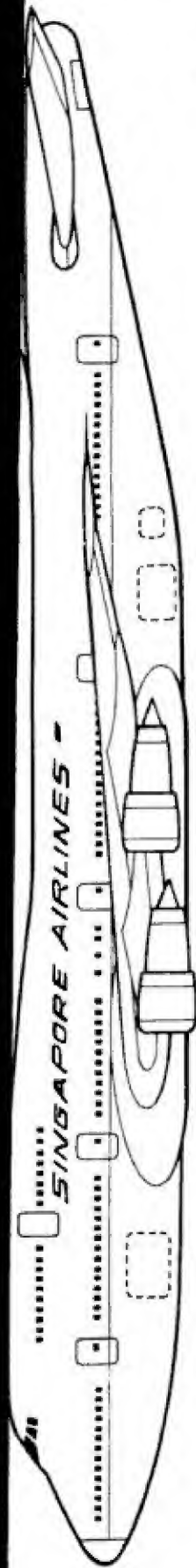
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Inverted Back

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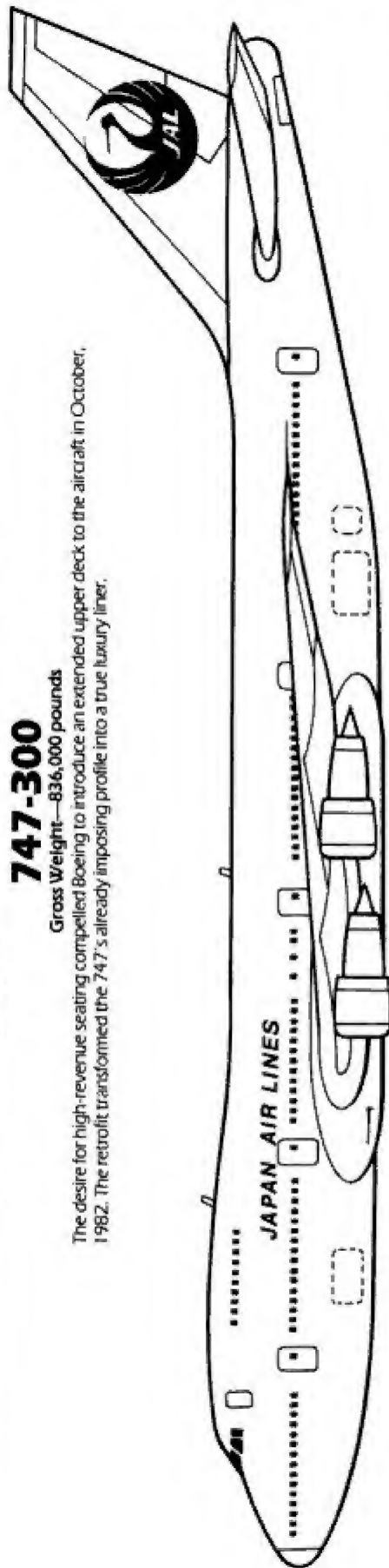




## 747-300

Gross Weight—836,000 pounds

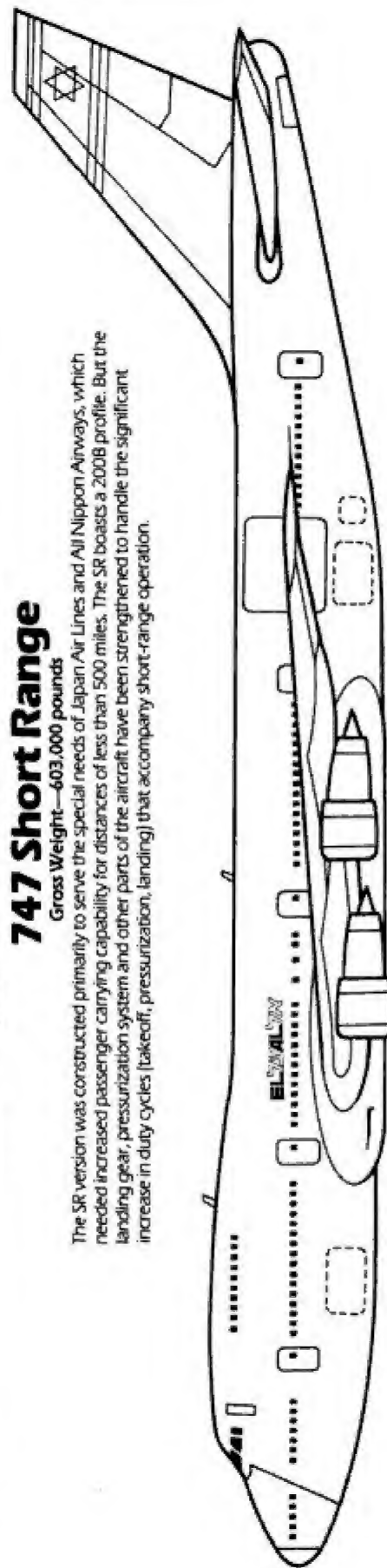
The desire for high-revenue seating compelled Boeing to introduce an extended upper deck to the aircraft in October, 1982. The retrofit transformed the 747's already imposing profile into a true luxury liner.



## 747 Short Range

Gross Weight—603,000 pounds

The SR version was constructed primarily to serve the special needs of Japan Air Lines and All Nippon Airways, which needed increased passenger carrying capability for distances of less than 500 miles. The SR boasts a 2008 profile. But the landing gear, pressurization system and other parts of the aircraft have been strengthened to handle the significant increase in duty cycles (takeoff, pressurization, landing) that accompany short-range operation.



## 747 Convertible

Gross Weight—836,000 pounds

Allowing 747 customers to adapt to shifting markets and customer demands, the 747 Convertible could be instantly switched from passenger to cargo mode because of its large side door and lifting nose section. The lifting nose—a feature important to nationalized carriers like El Al with frequent need for military airlift—also eased cargo handling burdens on the ground.

# Popul Mech





3 FIRST OFFICERS CONTROL COLUMN

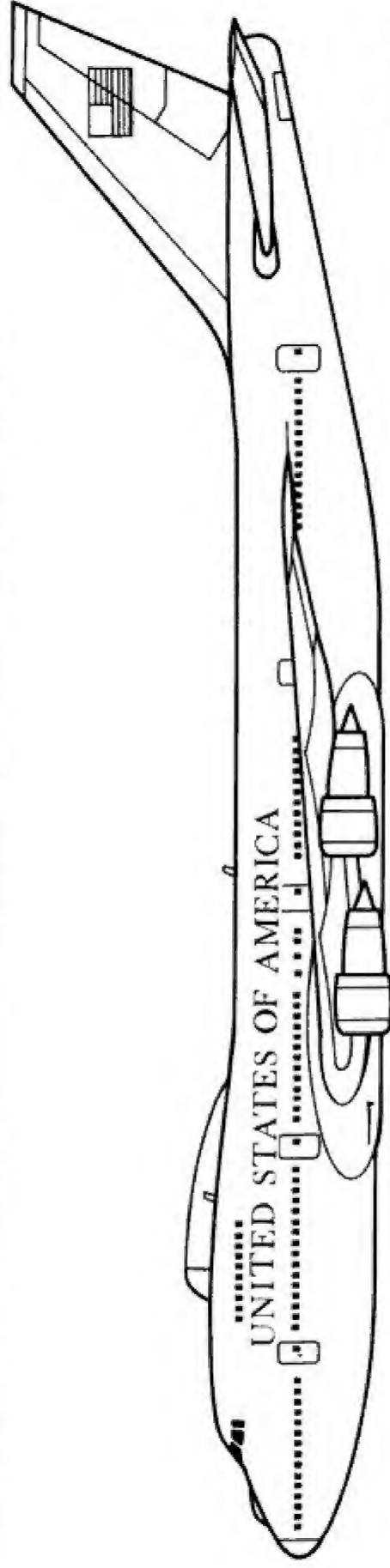
# Popular Mechanics

PAI ILLUSTRATIONS BY JOHN BATCHELOR  
© 1999 THE HEARD CORPORATION. ALL RIGHTS RESERVED



# 747-THE HEAVY HAULER

Since its initial rollout and first flight 20 years ago, the Boeing 747 has been called upon to perform numerous tasks—as a cargo link to Europe and the Pacific rim, as a magic carpet for high-flying vacationers, and as NASA's Space Shuttle motherbird, ferrying the orbiter back to Cape Canaveral after each mission. Excellent handling qualities, a superb safety record, and prodigious muscle give the 747 this unequaled versatility—for this century and beyond. The 747-400, the newest member of the 747 family, joins nine 747 variations that have changed the way we fly.



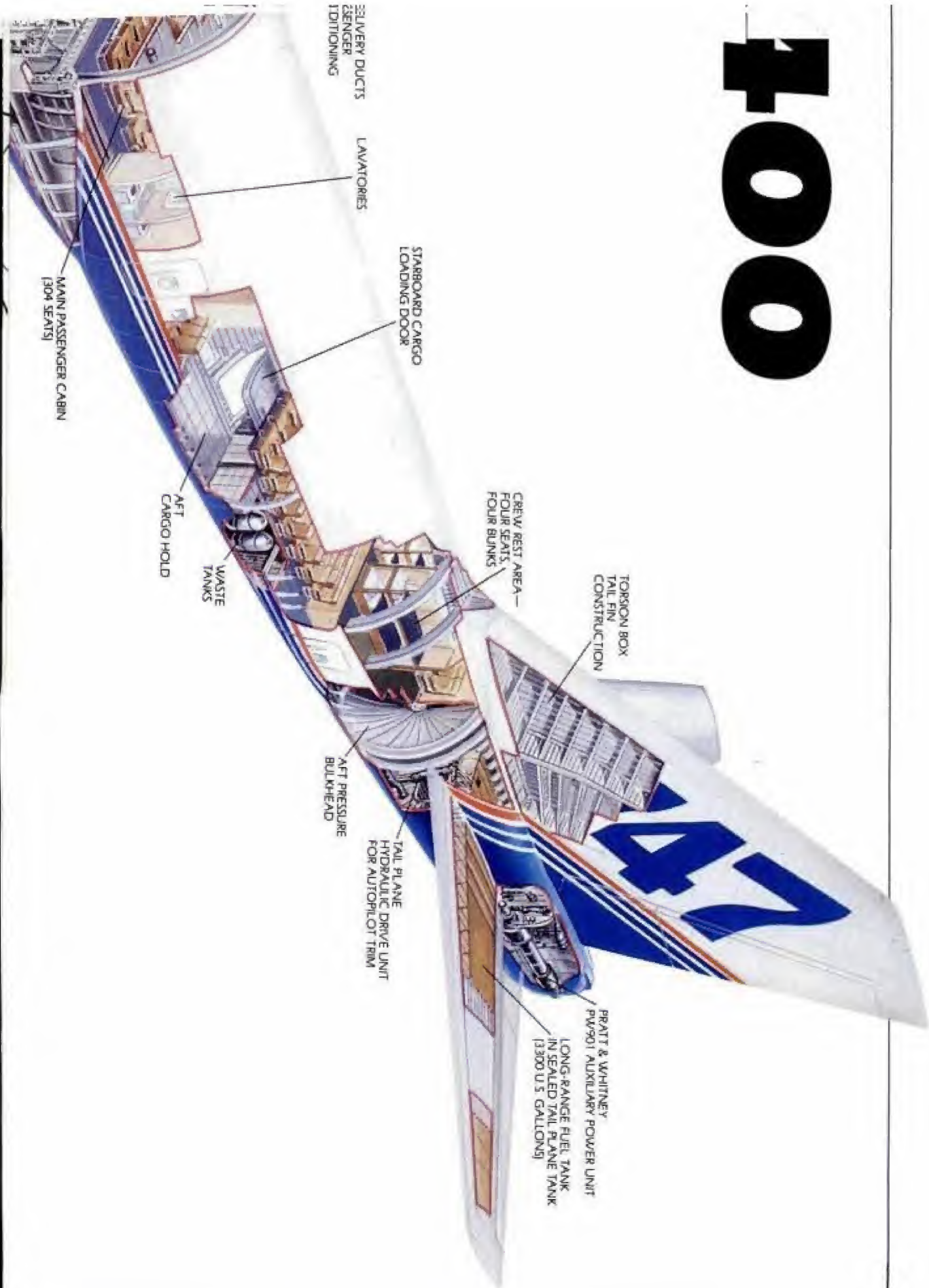
## 747-200B

**Gross Weight—836,000 pounds**

The basic 747 profile became firmly established on October 11, 1970, with the 200B's reworked upper deck. The change accommodated more first and business class passengers and fixed the 747's distinctive planform for more than a decade. One 200B was selected as the United States Strategic Air Command Advanced Airborne Command Post. A satellite receiver fairing was added to the 747's upper blister, along with a nose-mounted refueling receptacle.



# Four





said in the quiet cockpit since the takeoff roll began. "VI," he says, as the speed hits 155, and then "rotate" shortly after as the plane passes 165 knots. The captain brings the control column smoothly back until the attitude indicator on the CRT display shows a 14° angle and the nosewheel rises 50 ft. off the pavement. A few seconds later, liftoff occurs and N633US begins to fly.

As the altimeter winds past 1000 ft., the captain engages the autoflight system and the airplane turns out over the Atlantic, taking up—appropriately enough—a northwesterly heading. From this point, until it lands at Narita Airport in Tokyo, Northwest 17 will fly entirely by computer. If necessary, it will even touch down by itself and brake automatically to a smooth stop while tracking the runway centerline. The new carbon brakes in the 747-400 are 1800 pounds lighter than the steel brakes in earlier 747s. They're also supposed to offer better stopping power and increased longevity.

### Block to block

As N633US takes off, Pan Am Flight 101 touches down. The captain has set its automatic braking system at MEDIUM and the plane will need only a portion of the 11,000-ft. runway to stop. With maximum braking, spoilers and reverse thrust, N733 could stop in as little as 2200 ft.

As Pan Am 101 slows down, the passengers on the left side look out to see the newer airplane lifting off the parallel runway. The only difference they see is the distinctive winglets and the 280-in. stretch of the upper deck, which is also common to the 747-300 airliner.

For all intents and purposes, aside from its original 3-hole upper deck, N733 looks like a brand-new airplane and it is really as good as new. In March 1988 it emerged from its 18,000-hour, 5-year D-check—done at Pan Am's huge 4-plane facility at JFK—where every bit of paint was removed, every nut, bolt and fastener was minutely inspected, and all systems were checked and rechecked. The D-check took two months of labor to complete. Newer 747s require only one month for this service.

But the newer airplanes cost a lot more money. N733 cost \$21 million to buy in 1969. The price tag on N633US is more like \$125 million.

Yet with more and more people flying all over the world, there's a lot of work out there for 747s of all ages. Durability and cockpit advancements have made this 20-year-old design the airplane of tomorrow.

PM

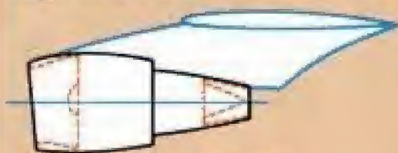
## TECHNICAL HIGHLIGHTS

### Profile Of A Giant

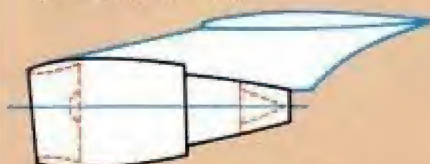


Basic dimensions of the 747-400 haven't changed from her older siblings. But wingtip extensions and winglets—adding 16 ft. to wingspan—have increased range.

### Engine Spotter's Guide



**PRATT & WHITNEY 4056**  
56,700 POUNDS THRUST



**GENERAL ELECTRIC CF6-80C2**  
57,900 POUNDS THRUST

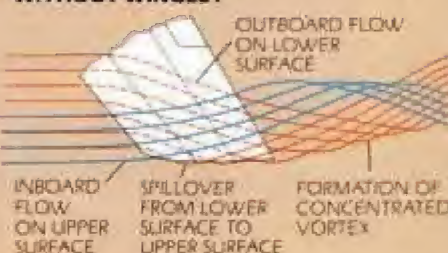


**ROLLS-ROYCE RB211-524C**  
58,000 POUNDS THRUST

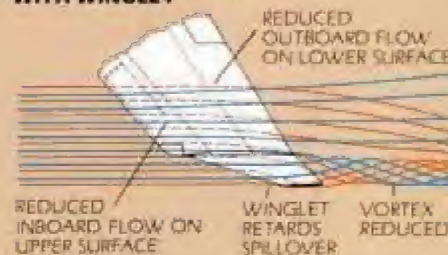
External silhouettes and thrust variations characterize the 747-400's three engine options.

### How Winglets Work

**AIRFLOW ON WINGTIP WITHOUT WINGLET**

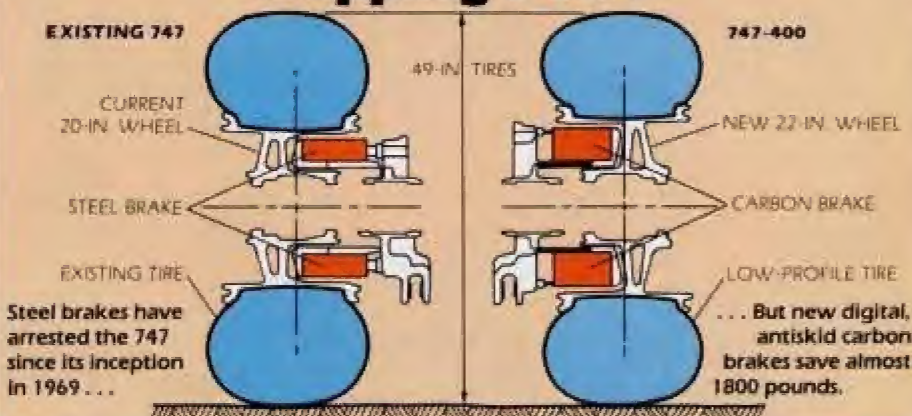


**AIRFLOW ON WINGTIP WITH WINGLET**



Wing extensions and winglets contribute to the 400's range and performance by reducing tip vortex drag.

### Stopping Power



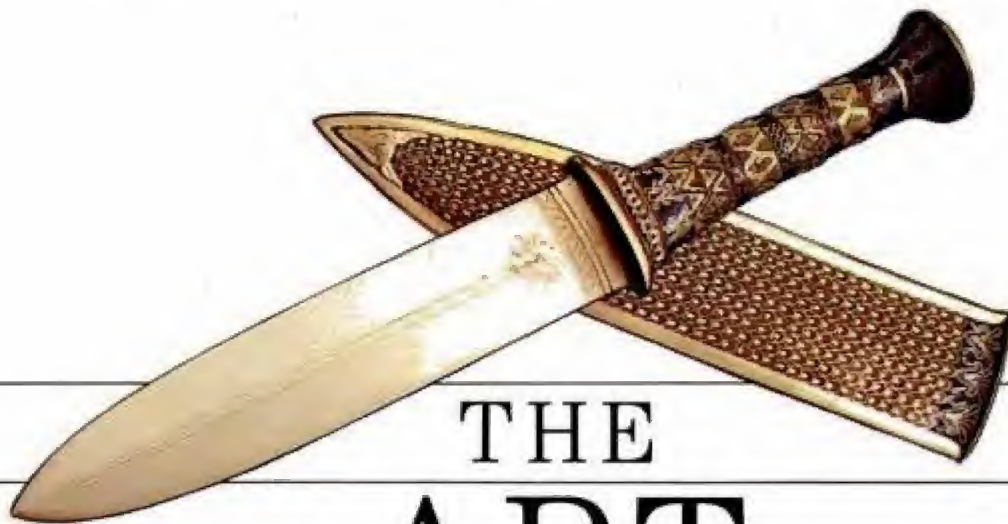
Steel brakes have arrested the 747 since its inception in 1969...

... But new digital, antiskid carbon brakes save almost 1800 pounds.









# THE ART OF THE KNIFE

Collectors pay up to \$50,000 for treasures from the knifemaker's hammer and forge that combine new technology with ancient skills.

BY BUTCH WINTER; PM Photos by Jim Weyer



It took \$50,000 in gold and labor to recreate King Tut's dagger (top). Carving the eagle handle (above) took Rick Jenkins 100 hours, while two artists collaborated on the engraved ebony-handled hunter's knife. The Hornet (opposite) is a fantasy shape in steel, amber, Cape buffalo and brass from Gil Hibben.



## THE ART OF THE KNIFE

**K**NIVES HAVE ALWAYS been regarded as treasured, even mystical, objects. Skill with a hammer and forge goes back thousands of years. Perhaps the most famous examples of refinement in knifemaking are the masterpieces found in the Tomb of King Tut.

Among the objects buried with the Egyptian Pharaoh Tutankhamen 3400 years ago were two daggers. One has a blade of iron and the other a blade of gold. The handles of both are decorated with gold beads, turquoise, lapis lazuli and other precious stones. It may seem strange to us now, but the dagger with the blade of iron, which was extremely rare in King Tut's time, was considered the most valuable.

### Fantasies in heavy metal

Thousands of years have passed since the original cult of the knife, but the old skills aren't forgotten. In fact, we're in the midst of a major revival today.

For example, the King Tut gold knife was recently recreated by master knifemaker Buster Warenski, of Richfield, Utah, for collector Phil Lobred. The project took 32 ounces of pure gold and five years to complete. The blade was reformed five times before the proper treatment was found and the inlaying, which includes handmade gold beads, was done while using a magnifying glass.

What's this one-of-a-kind dagger worth? Lobred estimates that it cost \$50,000 in materials and workmanship, and he's already been offered \$100,000.

Many of today's most complex and costly knives are more like fine jewelry than weapons or tools. One such knife, made by Gil Hibben of Louisville, Kentucky, evokes the image of an insect in flight.



Rambo III (right) has a heavy 18-in. tool-steel blade, while the Persian Bowie has an ornate carbon-steel blade known as Damascus steel.



The blade of the Ivory-handled Spiral Dagger was painstakingly ground into its unique shape instead of being heated and twisted.

The 13-in. dagger, dubbed The Hornet, has a blade for a stinger, an exotic guard with yellow sapphires for wings, a striped handle for a body (Cape buffalo horn for black and amber for yellow), and a silver butt cap mounted with rubies for a head and eyes. Hibben estimates that the knife, which took three months to make, is worth about \$4000.

### Modern masterpieces with an edge

Hibben is the designer and maker of an even more famous knife, the Rambo III. Hollywood star Sylvester Stallone, an avid knife collector, commissioned Hibben to make a modern version of the classic Bowie knife for his recent movie "Rambo III." Stallone purchased six of the knives, but an additional 12 prototypes were finished. Of these prototypes, one was recently sold for \$5000.

Another modern classic made by Ralph Turnbull of Rockford, Illinois, is an example of a hunting knife made of a solid 10-in. piece of stainless steel that features detailed engraving on the handle, spine of the blade, and ricasso, which is just ahead of the handle. The engraving was done by Mel Wood, of Sierra Vista, Arizona, and the knife, which has ebony in the handle, is valued at \$2000.

Creative carving is another form of embellishment as seen on Rick Jenkins' 10-in. eagle-handled knife. The handle, which took Jenkins 100 hours to carve, is made of solid ivory. The blade was ground and polished by Gordon Johnson, of Houston, Texas, and features a guard made from nickel silver. Market value is \$500.

The Spiral Dagger, made by Ted Dowell, of Bend, Oregon, is another ivory-handled knife, but the blade, which was ground to make each surface slightly hollow, is where the real artistry takes place. All fittings and finishes on the 15-in. Renaissance-inspired knife are immaculate and its value is estimated at \$2700.

The most difficult blade to work with is one of Damascus steel, which is found on the Persian Bowie, made by Steve Schwartzer, of Palatka, Florida. The 9½-in. blade was made by heating a piece of high-carbon steel and a piece of low-carbon steel until they reached welding temperature. Then they were hammered together.

The billet, as the workpiece is called, is then folded and twisted in various ways, and then heated and hammered again. This is done until there are as many as 1000 layers and a pattern emerges on the blade, in this case a delicate design known as Southern Damascus. The handle of the knife, which is worth about \$2500, is made from stag horn and the face of a wizard is carved into the butt end.

The cult of the knife is alive and well today among a talented new generation of craftsmen who are attracting growing numbers of collectors willing to pay big money for modern masterpieces in metal.

FM



COMPARISON TEST

# ANYWHERE DRILLS

The newest and most powerful cordless drills in a no-holes-barred confrontation.

BY THOMAS KLENCK,  
Associate Home And Shop Editor  
PM Photos by Brian Kosoff

**N**OT TOO LONG AGO, the odds were high that anyone with any mechanical inclination at all had at least one "cordless" drill in the toolbox.

Not only was the hand drill simple and effective, but the power to drive it was, quite literally, always at hand.

These days, however, it's the rare individual who hasn't replaced muscle with electric power. All you need is an outlet—the little terminal that links us with the miles of electrical umbilical cord that wind back to the generating station. Just plug in and you're *physically* connected—actually part of the power grid.

No outlet nearby? Enter the ubiquitous extension cord. With this, you can easily carry your drill up a ladder to the roof—at which point the plug invariably falls out of the outlet.

Well, there is a compromise between your go-anywhere, hand-operated drill and your powerful plug-in unit—the battery-powered cordless drill. And, judging by the 70-odd models now offered by major manufacturers, the idea is catching on. We've assembled eight of the best full-featured cordless drills on the market today for an intensive hands-on comparison test.

## Basic Features

Most cordless drills are powered by rechargeable 1.2-volt nickel cadmium batteries (cells). The number of cells determines the voltage of the drill, and higher voltage usually means more power. Drills are commonly available in 3.6, 6, 7.2, 9.6 and 12 volts. Drills below 7.2 volts are light-duty units designed for occasional use. On these less-expensive models, the batteries are usually integral with the



## ANYWHERE DRILLS



MILWAUKEE 0394-1



SEARS 11132



SKIL 2735:04



BLACK & DECKER 1987

tool—when the battery is dead, so is your drill until the tool is recharged. Heavier-duty models with independent battery packs allow you to keep a charged pack in the tool while a spare is in the charger.

Cordless drills are available as single-speed or 2-speed models. The 2-speed models add a high gear for jobs that benefit from higher rpm such as boring small diameter holes. The higher gear also allows you to drive screws faster.

In addition to fixed-speed control through gearing, manufacturers also offer an electronic variable-speed control that's activated by varying pressure on the trigger. This feature is invaluable for driving screws and can come in handy when using small drill bits.

Another popular option is an adjustable clutch for disengaging the motor at preset torques. It's handy in preventing overdriven screws that can result when using direct drive. However, if you're only driving a few screws, you'll probably spend more time finding the appropriate clutch setting than it would take you to do the job in direct drive.

A reversing switch for removing stuck bits and backing out screws is standard and most drills have an OFF position on the reversing switch to deactivate the unit. The drills also have a provision for chuck key storage.

### The tests

For our comparison test, we chose tools with variable speed, clutch and a voltage rating of at least 9.6 volts.

Where possible, we selected tools that had two speed ranges and 12 volts. With an average price of more than \$200, these tools are not cheap. However, we have seen some of these units discounted by up to 35 percent by mail-order suppliers.

All of the drills will easily sink a 1/4-in.-dia. x 3-in. lagbolt completely into the edge of a 2x4. Move up to 3/8 in. dia. and you've overstepped the limits of these tools. The extent to which they drove the heavier lagbolt was our [measure of torque](#) (see [Driving Power chart, page 132](#)).

We tested clutch performance by driving 3-in. No. 12 screws into a 2x4 at each clutch setting. Generally, in tools with 2-gear ranges, the same clutch setting would drive a screw further in low gear than in high. On some drills, this effectively provides twice the number of clutch settings than indicated on the dial. On other units, however, the difference was minimal and you can expect clutch performance to remain fairly consistent after changing gears (see [Clutch Performance chart, page 132](#)).

### Charger notes

Batteries tend to heat up during use. And, they shouldn't be charged when hot. The time it takes for the battery to cool should be added to the manufacturer's stated charge time to get a realistic idea of how long it takes to recycle a battery. It may take you up to 1 1/2 hours to recycle a recently drained battery pack with a 1-hour charger.

All fast chargers feature an automatic cutoff to avoid overcharging.

After charging is complete, some models go into a trickle-charge mode to keep your battery topped up (see [Cordless Drill Specifications chart, page 92](#)).

Of the drills that we tested, Bosch and Makita have very sensibly designed a charger/battery system that works with different types of tools that they offer. Adding other cordless tools can save money in the long run because you only have to buy the charging unit once.

### Black & Decker 1987

While this single-speed-range tool appears easy to handle when first picked up, it loses points when used continuously. Most disconcerting is the excessive heat generated under the metal front housing—it became literally too hot to hold.

The FORWARD/REVERSE/OFF switch is designed to be directly under the right thumb when holding the tool normally. Although operation is simple and convenient, having the sharp switch under your thumb for extended periods of time can be annoying. Unfortunately for south-paws, they'll find the switch hidden under the palm of their hand.

The clutch torque settings are too high for the normal screw sizes that you'd expect this drill to handle. On the highest clutch setting, this tool drove the head of a 3-in. No. 12 screw right through a 2x4. The lowest clutch setting drove the screw over 1 in. into the wood.

Although this unit wasn't spectacular, Black & Decker has introduced a



RYOBI BD-1025VR



PORTER-CABLE 9850



BOSCH 921 VSR



MAKITA 6093DW



new line of Univolt heavy-duty cordless drills. The Univolt system is intended to power a wide range of B & D tools. While we were only able to test a preproduction model, it's fair to say that we were favorably impressed.

### Bosch 921 VSR

This tool was undoubtedly the Cadillac of our test group. All the controls operate smoothly and are conveniently placed. The well designed FORWARD/REVERSE/OFF lever makes

driving and removing screws a breeze.

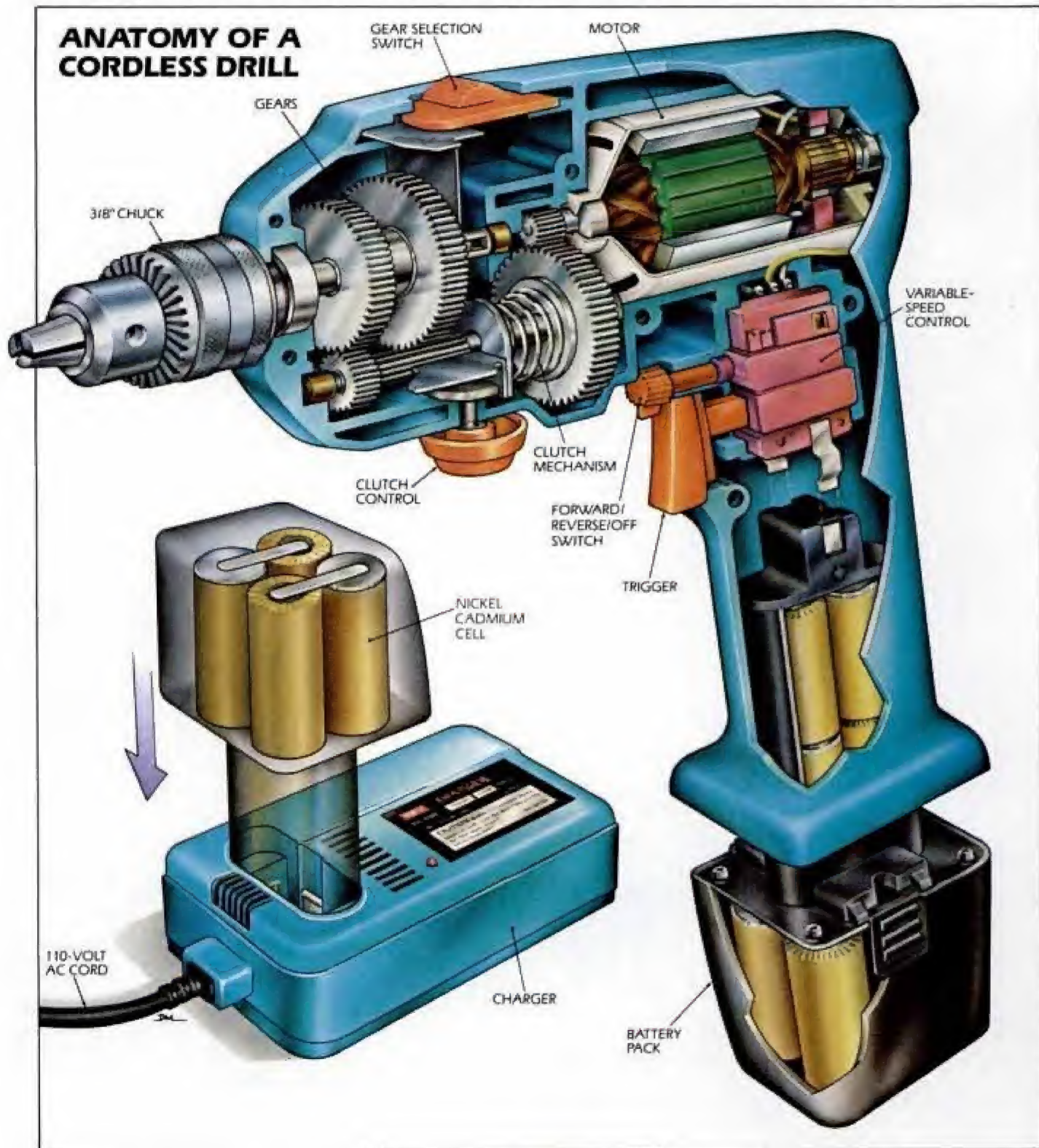
Although the Bosch unit didn't rank highest in any one area of our performance tests, it was generally near the top and we consider it one of the best tools for overall performance.

Clutch operation is very consistent when moving from high to low speed and the torque settings seem to be calibrated in a narrow range for light-duty screw driving—the highest torque setting drove our 3-in. No. 12 test screw about 1¼ in. into the wood.

### Makita 6093DW

The Makita drill has the most unorthodox housing design. The body is shaped so that it's most comfortable when the second finger is on the trigger. Unfortunately, it's uncomfortable to hold the tool any other way. A more general design would offer more freedom in how the tool is handled.

The REVERSE switch is placed on the back of the handle near the top. While it's not as convenient as a trigger-located switch, you'll never shift





## ANYWHERE DRILLS



Most units with two speed ranges use a sliding switch to change gears (right). The Makita switch (left) must be rotated 180°.



The clutch is mounted behind the chuck on the Porter-Cable, Black & Decker, Bosch, Milwaukee and Sears tools that were tested.



Skil and Ryobi drills feature a clutch mounted under housing and in front of trigger. Drill must be turned over to adjust clutch.



Lever-type reversing switch positioned near trigger is common to Bosch, Milwaukee, Porter-Cable, Ryobi, Sears and Skil.



The Black & Decker model 1987 has a sliding FORWARD/REVERSE/OFF switch. It's positioned to be directly under the right thumb.



The Makita reversing switch is a toggle design with no OFF position. It's placed out of the way at the back top of the handle.

it accidentally. This was the only cordless drill in our group that did not have an OFF switch. The top-mounted gear selection switch must be turned 180° to change gears. The switch on our unit was too small and stiff for easy operation.

The clutch torque settings of our test tool varied widely from high- to low-gear range. While clutch torque in low range seemed a bit heavy, switching to high range gives you another level of lighter torque settings.

This was the only tool in our group that featured an electronic brake that stops the drill as soon as the trigger is released. The Makita also has overload protection to help prevent motor burnout. This means that occasionally pushing the tool to its limits can be very frustrating—the tool repeatedly stops and you have to wait for the overload protection to reset.

### Milwaukee 0394-1

One gets the impression that the 0394-1 was designed and engineered by people who will use it every day. There's nothing fancy or innovative about the design—the tool is simply compact, light, comfortable and downright sensible.

However, the folks at Milwaukee have apparently decided to break from the norm in their approach to using available battery power. In terms of torque, our tests show this tool ranking at the top. You don't get all this power from 9.6 volts without a sacrifice—our run-time tests show this tool at the bottom of the field.

To make this tradeoff more acceptable, the Milwaukee engineers designed their charger to do its job in a half-hour—half the time of the other units. With two battery packs on the go, there doesn't seem to be any ap-

preciable difference in tool availability between this tool and most of the other units.

The clutch torque settings were widely spaced and fairly uniform between the two gear ranges. The highest setting drove a 3-in. No. 12 screw flush and the lowest setting drove the screw about 1/2 in. into the wood.

### Porter-Cable 9850

If you're looking for long run time and high torque, then this is the cordless drill for you. This is the best tool for large holes and heavy screws.

Although this 12-volt tool has the largest battery pack and is the heaviest in our selection, it's still comfortable to hold. The pack is held in place with a heavy spring-steel clip that also holds the chuck key. Removing the pack and key is no problem, but

*(Please turn to page 132)*

## CORDLESS DRILL SPECIFICATIONS\*

MANUFACTURER	MODEL	PRICE	VOLTAGE	BATTERY PRICE	CHARGE TIME (Hrs.)	SPEED RANGES (rpm)	CLUTCH POSITIONS	TRICKLE- <sup>2</sup> CHARGE MODE	12-VOLT <sup>3</sup> CHARGER	WEIGHT (Lbs.)	EXTRAS <sup>1</sup>
Black & Decker	1987	\$230	9.6	\$60	1	0-800	4	no	yes	3.75	A, D
Bosch	921 VSR <sup>4</sup>	\$223	9.6	\$49	1	0-400/0-900	5	yes	yes	3.75	
Makita	6093DW <sup>5</sup>	\$248	9.6	\$48	1	0-400/0-1100	5	no	yes	4	B, D
Milwaukee	0394-1	\$249	9.6	\$61.75	1/2	0-350/0-1000	5	no	yes	3.5	
Porter-Cable	9850	\$210	12	\$48	1	0-400	5	yes	no	4.5	B, D
Ryobi	BD-1025VR	\$219	9.6	\$66.80	1	0-350/0-1100	4	no	no	3.75	D
Sears	11132	\$100	9.6	\$28.89	1	0-600	3	yes	no	3	
Skil	2735-04 <sup>6</sup>	\$210	12	\$62	1	0-500/0-1650	4	yes	no	4	A, C

\*All drills come with battery pack and charger. 1. Included with drill - A: plastic case, B: metal case, C: extra battery, D: screwdriver bit. 2. Charger features trickle-charge mode after fast charge. 3. Charger available that plugs into car cigarette lighter. 4. Available with metal case as 921 VSRK. 5. Available without battery and charger as 6093D. 6. Available with single battery pack as 2735-02.



# HOME AND SHOP JOURNAL



## NEW TOOL

# ELECTRIC GARDEN TILLER

BY BRUCE KITZMEYER

**W**HEN we first decided to try out the new Mantis electric tiller, we were skeptical about its performance. After all, how well could a lightweight *electric* tiller stand up to the rigors associated with tilling? But after using it for several months, our skepticism evaporated. This machine never complained as we attacked soil filled with rocks, clay and gravel. It also excelled at digging deep holes for new tree plantings. By pulling back on the machine, and by rocking it from side to side, our progress was steady and almost effortless.

When this performance is combined with the quiet running of its 10-amp electric motor, it overcomes all the limitations associated with extension cords. If most of your work is far from a power source, this machine is not for you. We did, however, test it using over 200 ft. of extension cord and the machine revealed no loss of performance. Made by Mantis Manufacturing, 1458 County Line Road, Huntington Valley, PA 19006, it costs \$359 plus shipping, including the 30-ft. recoil extension cord shown in the photo at left. Various attachments are also available, including a dethatcher, soil aerator and edger wheel. **PM**



The tiller weighs just 26 pounds. And, for further ease of transport, has a carrying grip located on the handles just behind the motor.



Motor has three speeds with switch conveniently located below throttle handle. Adjust speed based on soil conditions.



To engage throttle, push in yellow **SAFETY SWITCH** button and pull back on throttle handle. Release handle and tiller stops.



Tiller comes equipped with two steel tine assemblies. Tines are attached to a horizontally aligned driveshaft with simple lock pins.



To remove a tine for maintenance or replacement, simply pull out the lock pin, then lift off the tine assembly from the driveshaft.





## **PM PLANS**

# **SPACE STATION**

Our stone-sheathed utility shed fills the bill for both town and country gardeners who need more room.

BY WILLIAM AND DIANE WINANS

Color photos: Design Photography  
Technical art: Eugene Thompson

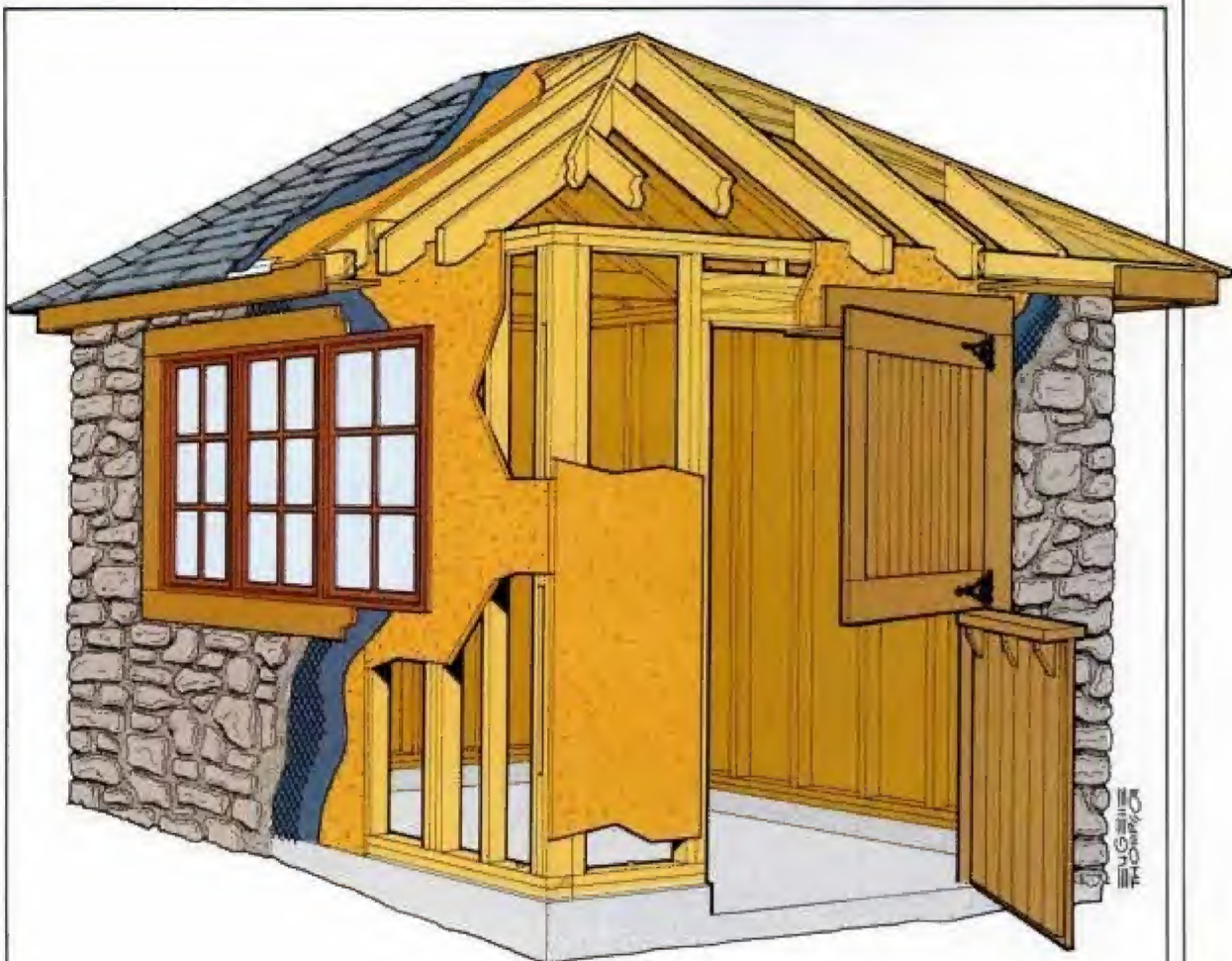
**W**HAT HOMEOWNER hasn't at one time wished for a dedicated tool storage shed—a place away from the house and garage where gardening tools and supplies could be neatly

stored. And, when the weather keeps your spade and pitchfork idle, you'd have your own private retreat for potting and indoor transplanting chores.

We've designed our stone utility shed to help make these dreams a reality. And, because it's based on designs of traditional stone estate buildings of the late 1800s, it's sure to add elegance to your garden scape.

The building is 8 ft. wide and 12 ft. long. And, although it looks like solid stone through and through, we've simplified the job by using Tennessee limestone manufactured veneer





Simple construction and modern veneer stone make our utility shed as easy to build as it is to look at. Dutch door provides ample access and large casement window makes interior spacious. Hip roof encloses handy storage loft and all trim is enduring cedar.



## Source List

- Summit III roof shingles: Georgia Pacific Corp., 133 Peachtree St., N.E., Box 105605, Atlanta, GA 30348
- Cierra casement window: Louisiana Pacific Corp., Building Products Div., 324 Wooster Rd., Barberton, OH 44203
- Waferwood sheathing: Louisiana Pacific Corp., 111 S.W. 5th Ave., Portland, OR 97204
- Tennessee limestone manufactured veneer stone: Coronado Products, Inc., 1325 6th Ave., N. Nashville, TN 37208
- Woodfield woodgrained Peg-Board paneling and hardware: Massnite Corp., 1 South Wacker Dr., Chicago, IL 60606
- Garden tools: True Temper Hardware Div., Box 3500, 465 Railroad Ave., Shiremanstown, PA 17011



stone. This is applied over ordinary 2x4 stud walls that have been sheathed with 5/8-in.-thick oriented-strand waferboard and covered with wire lath.

Although costs can vary, you should be able to buy the same materials that we used for about \$2000.

The large Dutch door openly welcomes your tiller, lawnmower or snowblower and when the weather is fine, you can open the top half for extra sunlight and fresh air.

On the inside, we've covered the walls with 1/4-in.-thick woodgrained Peg-Board so everything can be hung just where you want it. And, a small loft can be installed to increase storage capacity. Topping off the project is a charming hip roof that eliminates the need for the gable end construction found on standard roofs.

Our plan sheets clearly illustrate all the construction details and the plans come with a complete step-by-step instruction booklet. **PM**

## How To Order Plans

Plans for PM's small stone outbuilding consist of four 17 x 22-in. drawing sheets, a detailed 8-page instruction manual, and a complete materials list. A single set of plans costs \$18.50. If you need another set of plans to file for a building permit or to give to a contractor, each additional set will cost \$16 when purchased with the first set. Send your check or money order to Stone Outbuilding, POPULAR MECHANICS, Box 1014, Radio City Station, New York, NY 10101.

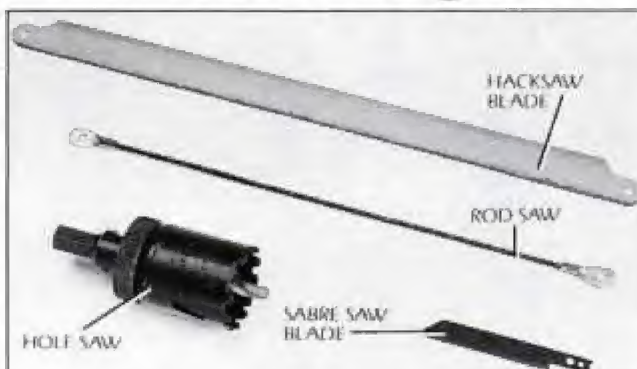
## TOOL TEST

### Grit-Edge Blades: Tackling The Tough Cuts

**W**HEN it comes to cutting extraordinarily tough materials, such as hardened steel, cast iron, ceramic tile, glass and fiber-reinforced cement, ordinary blades just can't cut it. For these demanding situations, try a super-tough Grit-Edge blade.

A Grit-Edge blade's cutting edge is made of thousands of tiny tungsten carbide chips that are bonded permanently to tough alloy steel. We tested a Grit-Edge hacksaw blade, rod saw, sabre saw blade and hole saw, and the results were remarkable.

The rod saw is an alloy steel rod that's surrounded completely by carbide grits. It's great for making curved cuts in ceramic tile, glass, sheet steel and slate. The sabre



Tough-cutting Grit-Edge blades come in a variety of sizes and styles. Cutting edge is made of durable tungsten carbide chips.

saw blade and hole saw both made quick, clean cuts in ceramic tile—no easy chore!

As you may have guessed, such superior performances do cost extra. A 12-in. Grit-Edge hacksaw blade costs about \$5. A 10-in. rod saw goes for around \$3.80. Sabre saw blades cost \$3.40 each. A 1 1/2-in.-dia. hole saw costs about \$27. The mating arbor and high-speed steel bit costs \$19. To cut ceramic tile, you'll need a carbide-tipped bit for the arbor. That costs another \$8.

Despite the premium paid, Grit-Edge blades outperform any blade that I've ever tested for making tough cuts. For details contact Remgrit Corp., 939 Barnum Ave., Bridgeport, CT 06608.

—Ro Capotosto



Closeup of a hacksaw blade shows thousands of tungsten carbide chips. Since there are no teeth, blade cuts in both directions.



Cutting glass, in this case a wine jug, would be impossible with a conventional blade. Grit-Edge blade cuts without slipping.



Rod saw is excellent for making irregular-shaped cuts in tile, glass, marble and hardened steel, as shown. Fits standard hacksaw.



Grit-Edge sabre saw blades cut ceramic tile easily for perfect-fit installations. Blades cut most masonry and abrasive materials.



To cut round holes in tile, slate, brick, clay pipe and steel, try a Grit-Edge hole saw. Available in sizes from 1/4 in. to 4 1/2 in. dia.



## HOW IT WORKS

# HEAT PUMP

BY THOMAS KLENCK,  
Associate Home  
And Shop Editor  
PM Illustrations  
by George Retseck

**I**F YOU HEAT your home with oil, gas, wood or coal, perhaps you've noticed that at the end of each winter all the fuel you've bought is gone. And, of course, so is the heat. As long as you've access to an adequate and economical fuel supply, the system works. However, recent years have shown us that fuel supplies are not inexhaustible. And as they become scarce, the price goes up.

There is an alternative way to heat your home that, except for the energy it requires to power motors, uses none of these traditional fuels. That alternative is the heat pump.

You may have heard that heat pumps take the heat from the cold outside air and use it to warm the inside of your home. You shouldn't feel alone if you find this concept difficult to grasp. After all, it's cold outside—and if there was any heat there, you wouldn't need to keep stoking the fire or turning up the thermostat. Well,

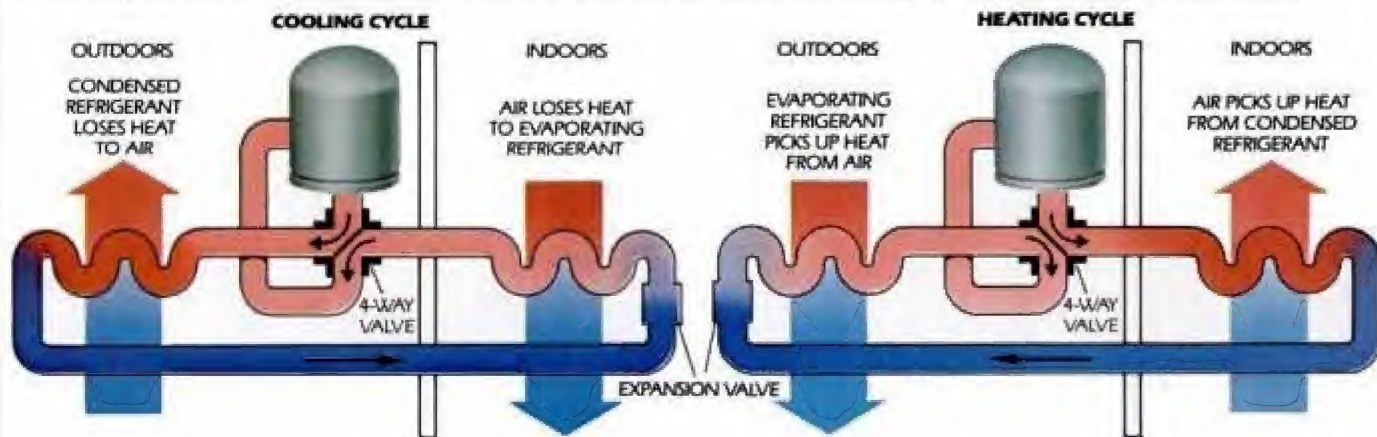
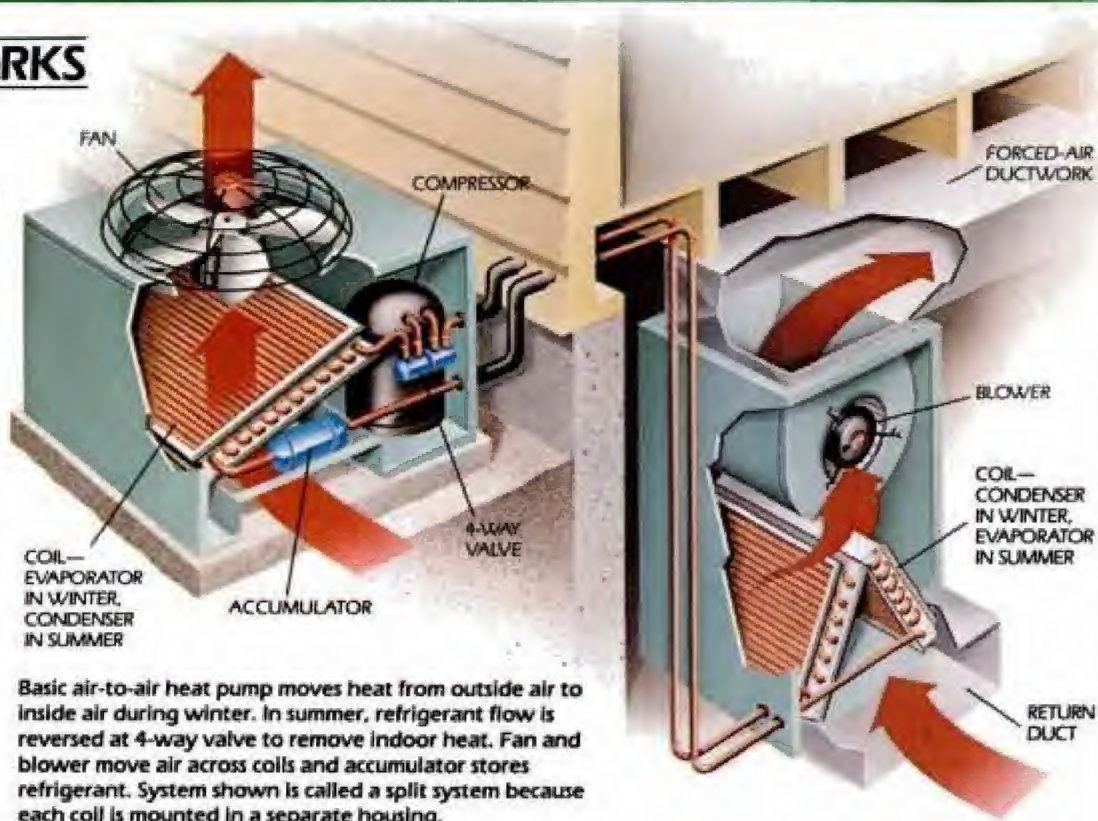
the simple fact is that there *is* heat in the outside air—even in the depths of winter. If you go outside on a winter day you may feel cold, but this reflects the level of heat at which you're comfortable. Hot and cold are sensations, but heat is a measure of energy.

Simply put, a heat pump is a link between two distinct areas of heat energy. Its function is to take some of the energy from one area—thus lowering this area's heat level, and then to deliver it to the other area.

You may not realize it, but you already have a heat pump in your kitchen—your refrigerator. Heat is moved from the air inside the refrig-

erator to the air in the kitchen. Air conditioners take heat from the inside of your home and deliver it outside. Reverse the process, and you're moving heat inside, while cooling the outside air. This reversibility means that heat pumps intended for heating your home are usually designed to cool it as well. A heat pump can offer year-round temperature control by simply moving the heat as required.

Heat always moves from a warm to a cold medium. In a heat pump, a medium called the refrigerant is brought to a temperature well below that of the outside air. Heat energy in the air then moves to the refrigerant.



In summer, indoor heat moves to refrigerant that has evaporated and cooled down. The refrigerant is then pumped through compressor and condenser coil where increased heat moves to outdoor air.

In winter, 4-way valve reverses flow. Outdoor coil becomes evaporator to gain heat and indoor coil becomes condenser to release heat. Expansion valve reduces pressure to facilitate evaporation.



To achieve its low temperature, the refrigerant is allowed to evaporate, which lowers its heat energy. If you've ever applied rubbing alcohol to your skin, you've seen the effect. As the alcohol evaporates, the heat of your body moves to the vapor and your skin feels cooler. Part of a heat pump is the evaporator coil where the refrigerant, after passing through an expansion valve that reduces pressure, evaporates (boils) and picks up heat. In the heating mode, the evaporator is outside the house.

Most heat pumps use a refrigerant that vaporizes at a very low temperature. Freon 22, for example, boils at -21.7° F. But, to get the refrigerant to evaporate, it must first be liquefied. This is accomplished by utilizing a simple principle, namely, the point at which a refrigerant evaporates or condenses varies with the pressure applied to it. This phenomenon can be seen in the operation of an ordinary pressure cooker. By maintaining high pressure inside a vessel, water will no longer boil at 212° F, but will remain liquid at a higher temperature.

In the same way, by pressurizing the refrigerant, its normally low evaporation point can be raised so that it liquefies or condenses at a higher temperature than normal.

The pressure is achieved by a com-

pressor and the condensation takes place in a condensing coil. After the evaporating refrigerant has gained heat from the air outside your home, the compression and condensation increase its heat level to a temperature higher than the air inside of your home. The heat then moves to the cooler air and your house is warmed. After giving off the heat, the refrigerant moves to the expansion valve and evaporator coil for another cycle.

To run as an air conditioner, the inside air is treated as the heat source rather than the outside air. The indoor coil becomes the evaporator and the outdoor coil acts as the condenser. This is accomplished by a 4-way valve that reverses the flow of refrigerant.

Most domestic systems are air-to-air systems—heat moves from one air medium to another. In the heating mode, the outside air is the source of the heat. This means that the lower the outdoor temperature, the less heat your unit has to work with. In northern areas, it's not unusual to pair a heat pump with a traditional heat source that helps out.

Heat pumps don't necessarily need to use air for a heat source. The evaporator coil can be installed underground below the frostline, or in a well, lake or river. These alternatives provide a more stable source of heat.

The efficiency of a heat pump is measured by the amount of heat (BTUs) it provides your home, divided by the amount of electrical energy (in BTUs) needed to operate the system. The resultant figure is called the coefficient of performance or COP. Electrical resistance heating, for example, has a COP of 1. By comparison, a heat pump with a COP of 3 would use one-third the electricity to produce the same heat.

However, the COP rating corresponds to a specific heat source temperature. Assume that the air inside your home must be brought to 70° F. Heat pumps typically have two COP ratings: one that indicates efficiency when the air outside is 17° F and the other when the air is 47° F. The lower the temperature, the lower the COP and the more that you'll pay for heat.

In contrast, the efficiency of gas, oil or electric resistance heat production is not affected by the outdoor temperature. The cost per BTU is constant. The amount of energy that you use from these sources is more related to how well-insulated your home is.

While heat pumps have been used effectively in most areas of the country, their unique qualities make them particularly relevant to locales where both heating and air conditioning are of equal importance. **FM**

## VIDEO PREVIEW

### NEW FURNITURE REFINISHING TAPE

**F**OR THOSE OF YOU who would like to try your hand at some furniture refinishing, I can't think of a better introduction than Bob Flexner's *Refinishing Furniture* videotape. It runs about 60 minutes and is loaded with authoritative tips, techniques and products that should yield professional results, even for the beginner. His approach is very fast-paced and covers a lot of ground. Along the way, he combines a genuine sensitivity for old furniture with a healthy dose of good common sense. If he has a bias, it's one that I share, namely it's better to repair—and preserve—an old finish than to replace it with a new one that will have much less character. The tape includes a 16-page companion booklet that covers safety issues, suppliers and other reference material. It costs \$32.45 postpaid and is available in both VHS and Beta formats. Order from the Taunton Press, 63 South Main St., Box 355, Newtown, CT 06470.

—Steven Willson





## ELECTRICAL BASICS

# GROUND FAULT INTERRUPTERS

TEXT AND PHOTOS  
BY MERLE HENKENIUS

Ground fault circuit interrupters protect you and your family from electrical injury in high moisture areas like bathrooms and kitchens. They are also used in receptacle circuits on the outside of your house.



To install GFCI receptacle, shut off power, pull out existing receptacle, and check for current between black terminal and ground.



GFCI breakers are identified by a test button and a dedicated neutral conductor, which on this model is the coiled white wire.



Using proper wire nuts, attach incoming black and white wires to GFCI line-side lead, and outgoing wires to load-side leads.



GFCI adapters are also available. To install, remove covering plate, plug into existing receptacle and secure with the center screw.

**WE** HAVE all heard of electrocutions resulting from a radio or hair dryer falling into a bathtub. But fewer of us may be aware of the threat posed in the kitchen or outside the house when working with electric appliances or tools. The truth of the matter is simple: Water and electricity are a bad combination. It is, however, reassuring to know that such tragedies are completely unnecessary today. Inexpensive and easy-to-install ground fault circuit interrupters, called GFCIs, are designed to keep you from harm's way.

A GFCI senses the slightest imbalance between the hot and neutral sides of a circuit. If we, and the water around us, were to divert current from a circuit, the GFCI would sense this irregularity and interrupt the flow of electricity within  $\frac{1}{40}$  of a second. The National Electrical Code now requires ground fault protection in all bath outlets, in all kitchen outlets—within 6 ft. of a sink—and in all outdoor receptacles.

How can you tell if you have GFCI protection? It's usually pretty easy. A GFCI receptacle—like the one shown—will have a TEST and a RESET button on its face. If you find no test buttons, check your main service panel. Your home may have ground fault protected circuit breakers. These, too, will have test buttons, in addition to dedicated neutral conductors.

If your home is without GFCI protection, you'll have three choices. Buy a surface-mounted adapter, for around \$20, that simply plugs into an outlet, giving you protection at that outlet only. Secondly, replace a standard receptacle with a GFCI receptacle, about \$13, and have protection at that outlet and at all outlets following it on the circuit. Finally, you install a ground fault breaker in your service panel at a cost of around \$40.

For most of us, a GFCI receptacle is the most appealing option. As most homes have separate bath and kitchen circuits, you'd need at least two \$40 breakers. By placing a GFCI receptacle early in a circuit, you'll protect several outlets for only \$10 a circuit. This receptacle hookup is shown at left. Keep in mind that the line-side leads of the GFCI should be attached to the wires that come from the service panel and the load-side leads are attached to the wires that feed the other receptacles in the circuit. **PM**



# HANG TOUGH.

The 1989 Dodge Raider. It's everything you'd ever expect from a rugged import sport utility. It's also a lot more than you'd ever imagine. An available new fuel-injected V-6. On-demand 4WD. Inside, a wide range of amenities like wall-to-wall carpeting and bucket seats turn this tough 4x4 into a smooth, comfortable pleasure craft. So when it comes to standards, our Raider leaves every other Japanese 4x4 in the sticks.\* And that's tough luck for the competition. The Dodge Raider. Because when you're really tough, you know it.

\*Based on '88 competitive data ('89 competitive data incomplete at time of printing).

BUCKLE UP FOR SAFETY.

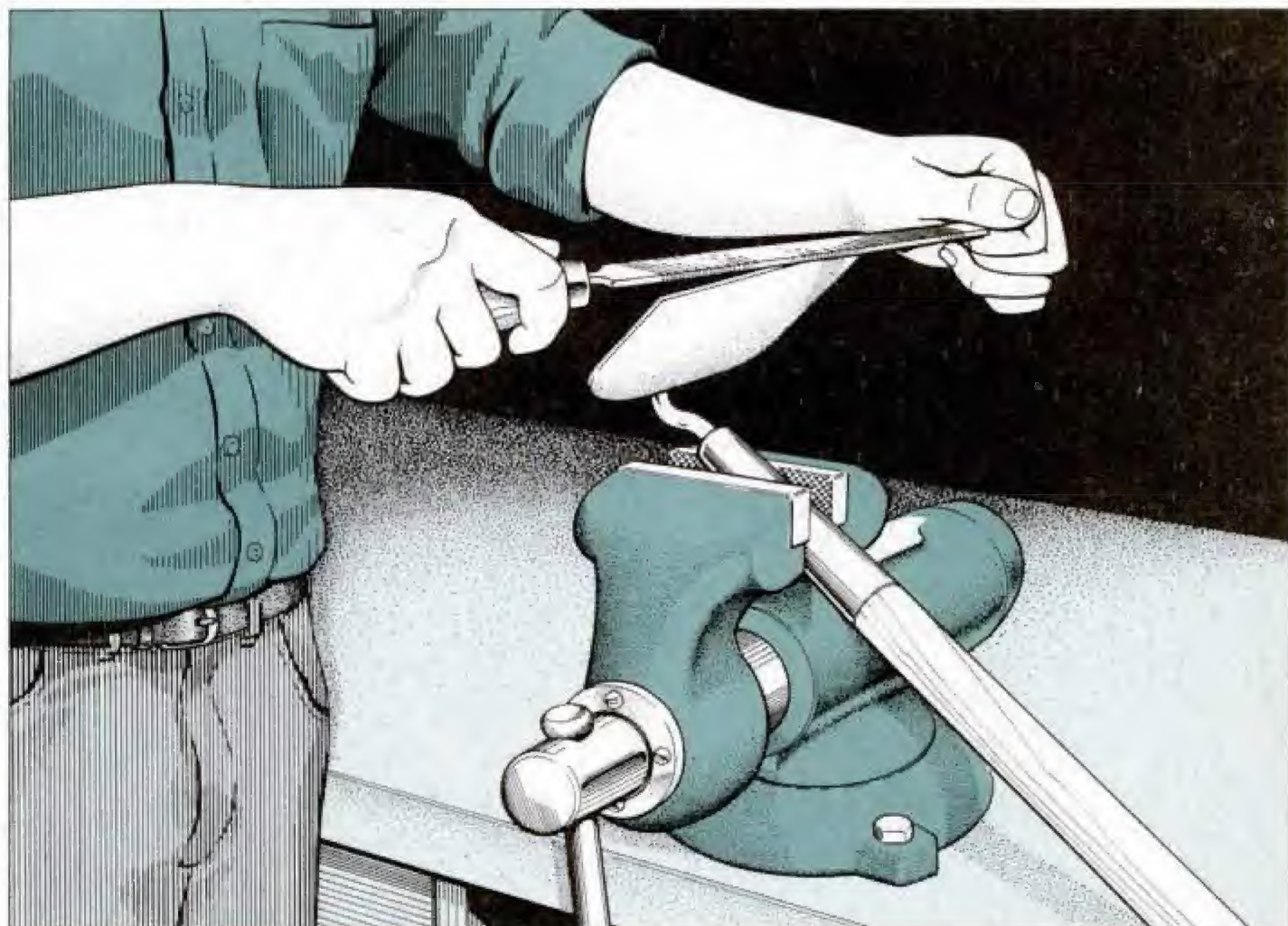


**THE TOUGH NEW  
SPIRIT OF DODGE**  
THE PERFORMANCE DIVISION OF CHRYSLER MOTORS



# How To Maintain GARDEN TOOLS

BY ROSARIO CAPOTOSTO, Contributing Editor; PM Illustrations by George Retseck



**A**S FEBRUARY melts into March and old man winter's chilly grip begins to loosen and slide away, our thoughts turn to springtime, warmer weather and outdoor activities. To millions of homeowners, spring also means gardening, landscaping and lawn care.

To some, these chores are considered a hobby and cause for excitement and anticipation. To others, they are simply just that, chores. However you look at it, it makes sense to keep lawn and garden hand tools in tiptop shape. Simple routine maintenance will pay off in safe, effective and long-lasting tools. If this isn't incentive enough, check out the cost of new gar-

den tools during your next trip to the hardware store. You may be surprised just how much a good shovel or garden rake costs these days.

Here, we show how to maintain and repair 12 different lawn and garden hand tools. Also, how to repair or, if necessary, replace a wooden handle. Plus, for those who own a reel-type push lawnmower, we show an easy way to sharpen the blades.

## Of files and stones

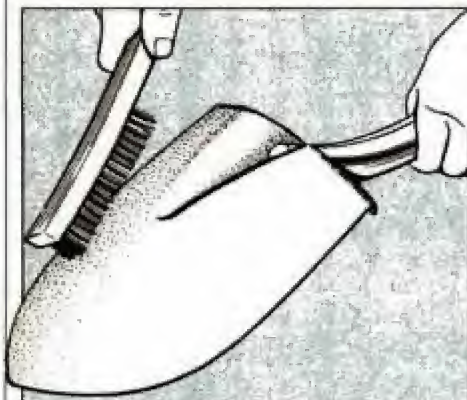
For most sharpening jobs, a fine or medium-fine single-cut file will suffice. A coarser double-cut file can be used when heavy stock removal is required. If an edge is badly nicked or

damaged, use a bench grinder to reshape the edge. Then, sharpen the cutting edge with a file or stone. Regardless of the sharpening method you use, be sure to maintain the tool's original, factory-ground bevel angle.

The proper filing technique is a 2-hand job, as shown in the illustrations. Apply pressure on the forward stroke only. Lift the file on the return stroke. Use a file card or wire brush to clean the file.

Sharpening stones come in various shapes and sizes in fine, medium and coarse grits. Stones may be used instead of a file or in conjunction with one. Always use lubricating oil on a stone to float away metal particles.





**1** Extend the useful life of tools by removing rust immediately. Use a wire brush or steel wool to expose clean, bare metal.

## Sharpening edges

■ **Hoe**—A hoe's cutting bevel is on the outside surface of the blade. Secure the hoe in a vise and, using a single-cut file, such as a mill bastard file, sharpen the edge. Be certain to maintain the original bevel angle. Also, advance the file forward and laterally simultaneously so that each stroke files across the entire edge.

■ **Shovel**—Before sharpening a shovel, inspect the blade for rust. Remove rust down to bare metal using steel wool or a wire brush (Fig. 1). To deter further rusting, apply a thin protective coat of oil to the blade with a soft cloth (Fig. 2).

Since a shovel blade often has a damaged digging edge (due to surprise encounters with buried rocks), it may be necessary to start filing with a coarse double-cut file (Fig. 3). Continue filing until all nicks and damaged spots are removed. Then, select a medium-fine, single-cut file to sharpen the digging edge.

■ **Grass/weed cutter**—The easiest way to sharpen the corrugated blade of a grass/weed cutter, also known as



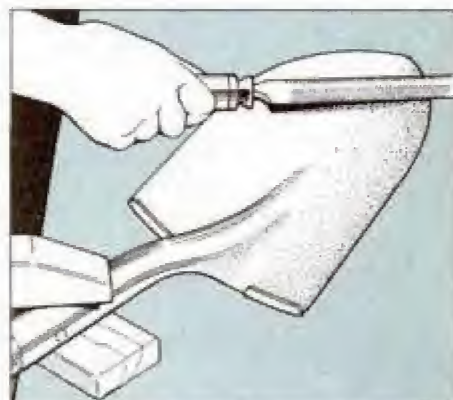
**2** Wash off caked-on dirt and mud. Then, use a soft, clean cloth to apply a light coat of oil to protect the metal blade from rust.

a grass whip, is to remove the blade from the handle and screw it to a wood block. Fasten the blade so that one edge overhangs the block slightly. Then, clamp the block in a vise. Sharpen the edge with a stone or single-cut file. Advance stone or file on the upstroke, as shown in Fig. 4.

■ **Pruning shear**—The small, curved jaw of a pruning shear is best sharp-



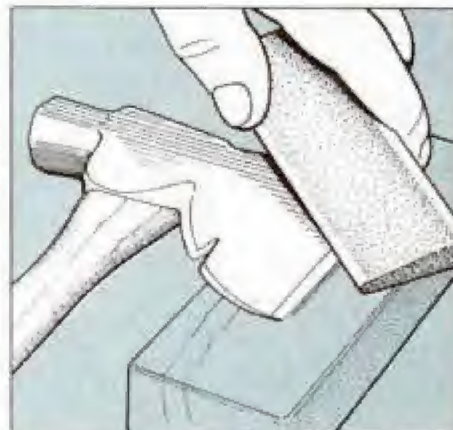
**7** Disassemble lawn edger and remove burrs from circular blade with a flat stone. Sharpen the teeth with a fine file or stone.



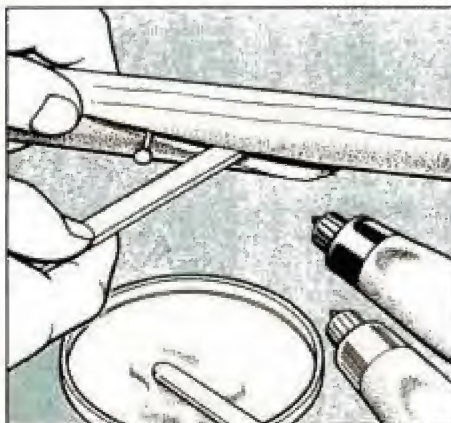
**3** Clamp shovel to a bench, for sharpening. Start with double-cut file to reestablish bevel. Sharpen edge with a single-cut file.

ened with a small stone (Fig. 5). Stroke the beveled edge in continuous sweeps. If a wire edge (burr) forms on the back of the jaw, hold a stone flat against the jaw and rub lightly.

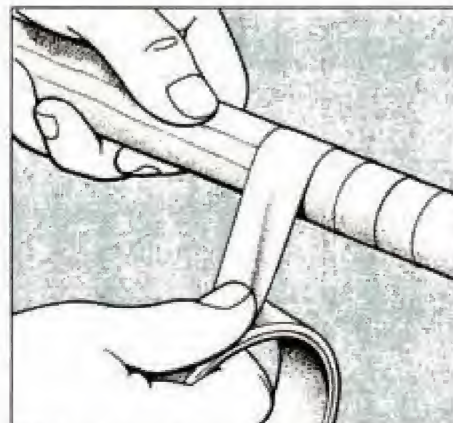
■ **Hedge clippers**—Sharpen hedge clippers with a fine, single-cut file. The secret is to file in straight strokes across the cutting edge while holding the file perpendicular to the blade



**8** Use coarse stone to reshape cutting bevel on a hatchet. Then, hone edge with a fine stone. Rest hatchet on a wood block.



**11** Repair split handle with epoxy adhesive. Wedge open split with a nail. Mix 2-part glue and spread it in split with a stick.

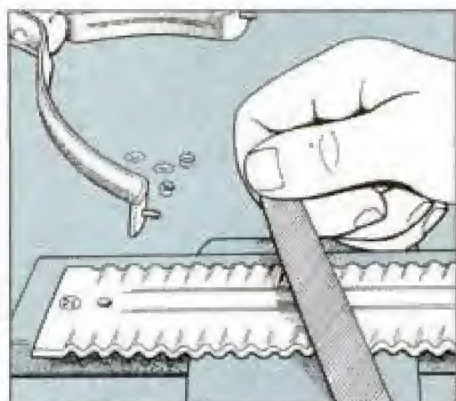


**12** Hold glued-up split closed with tape. Be careful not to squeeze out too much glue. Leave the tape until the glue is cured.

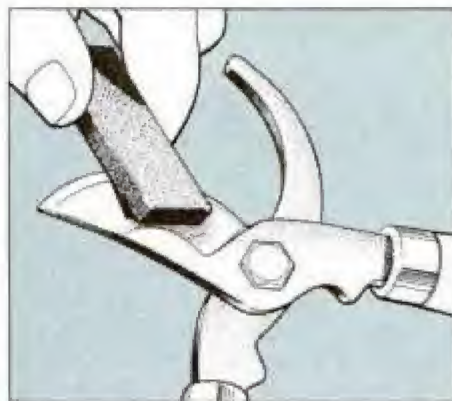


**13** Smooth rough spots on wooden handles to reduce the chance of getting splinters. Work sandpaper strip back and forth.

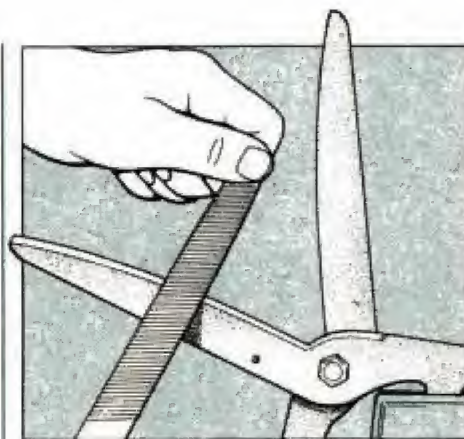




**4** Sharpen weed cutter's blade with single-cut file. Screw blade to wood block with edge overhanging. File on upstroke.



**5** Use a small, flat stone to sharpen pruning shears. Hold stone at original bevel angle and make several sweeping strokes.

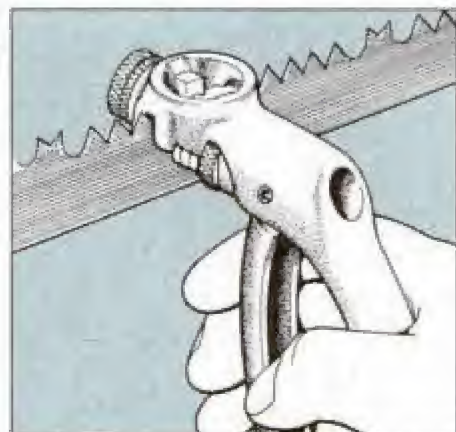


**6** Sharpen hedge clippers with a fine, single-cut file. Secure clippers in vise and make straight, in-line strokes across the blade.

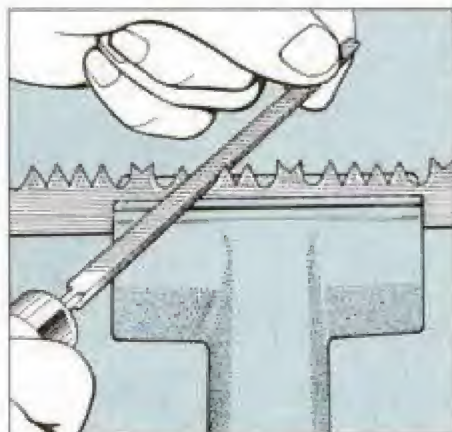
(Fig. 6). Don't slide the file laterally. This straight-stroking technique forms tiny serrations on the cutting edge that help prevent twigs and branches from sliding out from between the blades as the handles close.

■ **Lawn edger**—To sharpen a lawn edger, first disassemble the tool's head. A typical edger has two blades: one rotating circular blade with deep

teeth, and a stationary diamond-shaped blade. The teeth of the circular blade often have burrs due to contact with a sidewalk or curb. Hold a sharpening stone flat against the blade and rub lightly to remove the burrs (Fig. 7). Sharpen the bevels on each tooth with a small, narrow stone or fine file. Sharpen the stationary blade in the same manner.



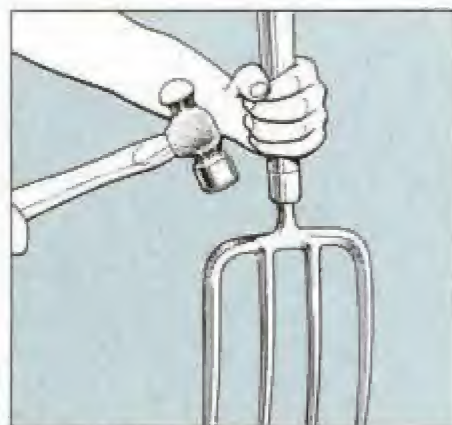
**9** Crosscut teeth of a timber-cutting bow saw are set. They're bent alternately to left and right. Use a saw set to reset the teeth.



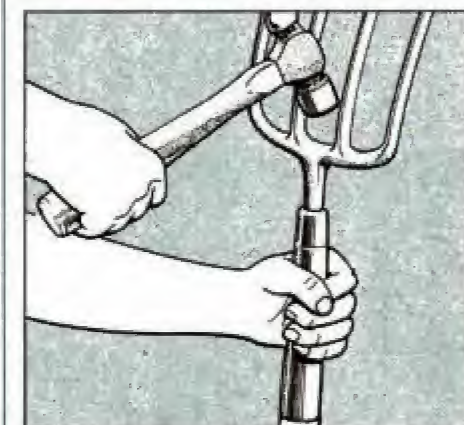
**10** Clamp blade close to teeth to prevent chattering. Using a triangular file, sharpen crosscut teeth to match the original bevel.



**14** Using a cloth, rub boiled linseed oil into the handle to make the wood weather resistant. Repeat this treatment annually.



**15** Broken handles are beyond repair and must be replaced. Use a ballpeen hammer to separate fork tang from handle sleeve.



**16** Using a ballpeen hammer, drive the fork onto a new handle. Be sure to hold the handle off the floor while hammering.

■ **Hatchet**—Sharpen a hatchet first with a coarse stone to redefine the cutting bevel. Then, hone the edge with a fine-grit stone. Hold the hatchet against a wood block during sharpening to stabilize it (Fig. 8). If the head is loose, drive a steel wedge (sold at hardware stores) into the end of the handle, as shown in Fig. 20.

■ **Bow saw**—Cutting green wood causes the teeth of a bow saw to lose their set which, in turn, reduces the saw's effectiveness. Using a saw set, reset the crosscut teeth (Fig. 9). Note that the raker teeth—the double-pointed teeth—are not set. To sharpen the teeth, clamp the saw blade in a vise and use a triangular file to sharpen bevels on each crosscut tooth (Fig. 10). The raker teeth aren't beveled. File them straight across.

## Handle repair

It's very important that all tool handles fit securely. Never use a tool with a loose, split or cracked handle. Note that some minor splits can be repaired, as shown, while in other cases, the handle must be replaced.



**Exception:** Always replace a damaged handle of a striking tool such as a hatchet or sledge hammer.

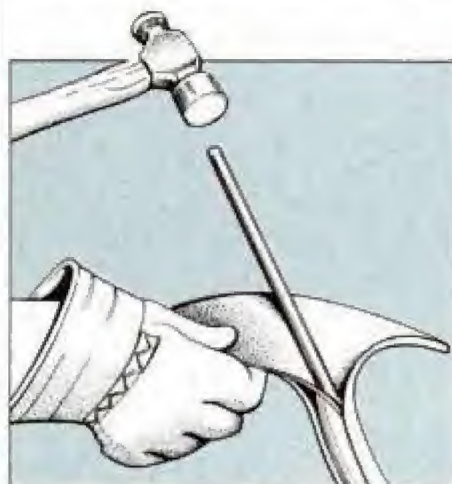
Repair a split handle with epoxy adhesive. Wedge open the split with a nail and spread the glue with a stick (Fig. 11). Pull out the nail and tape the split closed (Fig. 12). After the glue dries, sand the entire handle smooth to prevent splinters (Fig. 13). Finally, rub the handle with boiled linseed oil to protect the wood (Fig. 14).

## Sharpening a reel mower

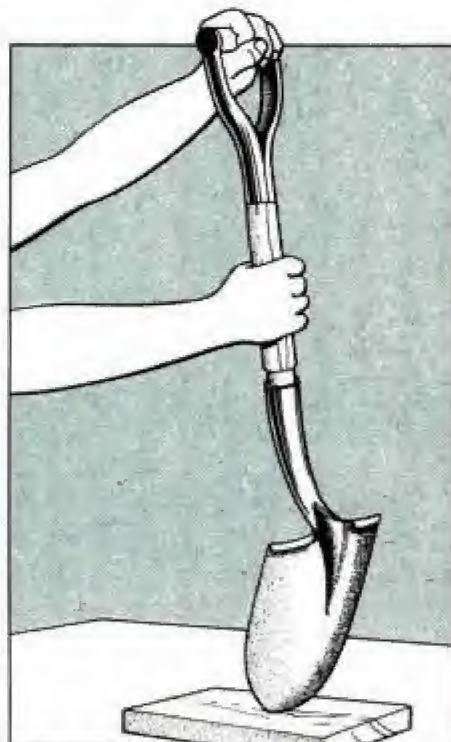
Reel-type lawn mowers have spiral-shaped blades that make sharpening them quite tricky. However, an easy way to touch up the cutting edges is with automotive grinding compound, also called lapping and grinding compound. It consists of abrasive grit suspended in heavy grease.

First, slide a flat sharpening stone back and forth along the mower's bed knife to dress the edge (Fig. 22). Next, adjust the bed knife so that it barely touches the blades as the reel is rotated by hand. Then, apply a bead

of compound along the edge of the bed knife (Fig. 23). Finally, slowly rotate the reel backward about four complete revolutions (Fig. 24). Wipe off the compound with paint thinner and test the mower. If necessary, readjust the bed knife for clean cuts. **PM**



**17** To replace a spade's handle, remove the rivet holding the handle. Then, use a steel rod and hammer to drive out handle.



**18** Force new handle into socket and strike against wood block to seat it fully. If necessary, trim handle slightly.



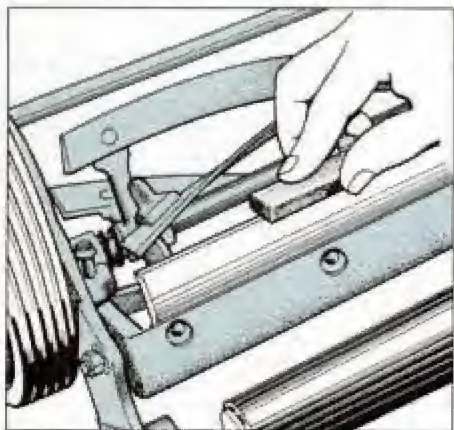
**19** Secure the loose head of a cultivator by filling socket with epoxy adhesive. Five-minute epoxy is ideal for quick repairs.



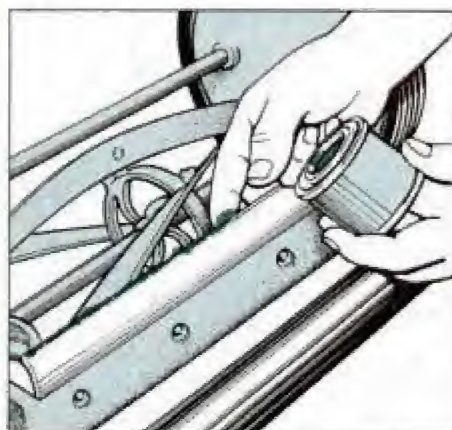
**20** To ensure a tight-fitting hatchet, drive a steel wedge into the top end of the handle. Position wedge at 90° to hatchet head.



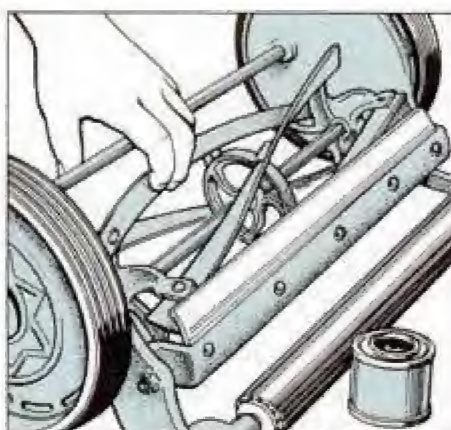
**21** Some garden sprayers have a leather washer attached to plunger end. Apply oil to washer to keep leather from drying out.



**22** Turn a reel-type mower upside down for sharpening. First, slide a flat sharpening stone back and forth across the bed knife.



**23** Adjust bed knife so each blade barely touches it. Then, apply a bead of automotive grinding compound to bed knife.

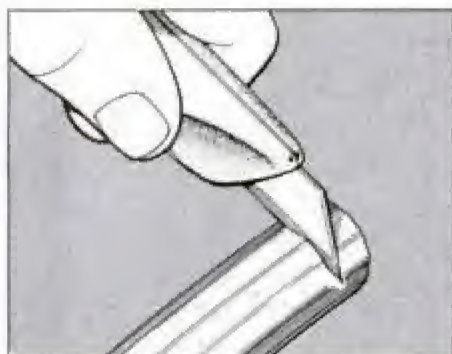


**24** Slowly rotate reel backward so each blade makes light contact with bed knife. Make four complete revolutions.

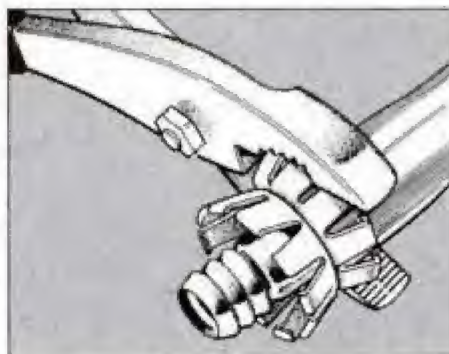


# How To Repair A GARDEN HOSE

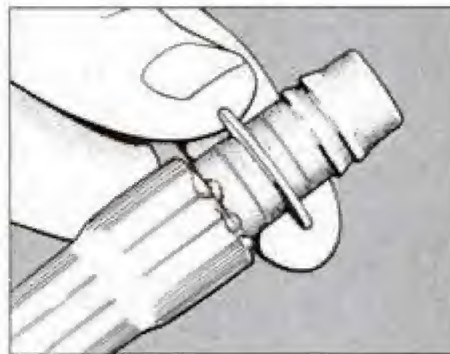
BY ROSARIO CAPOTOSTO, Contributing Editor; PM Illustrations by George Retseck



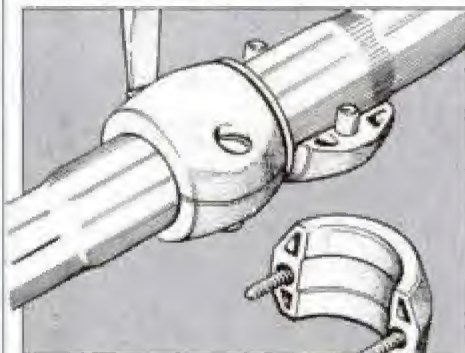
**1** When repairing a hose, use a sharp utility knife to cut out damaged section. Be sure to trim the end as square as possible.



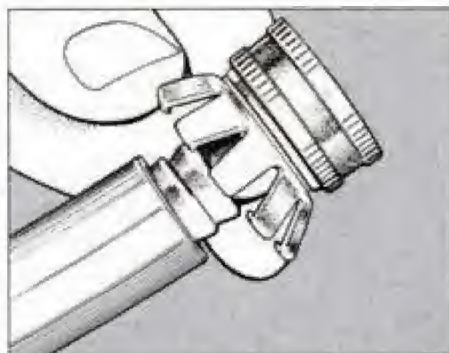
**2** Secure clinch-type fitting with pliers. Squeeze metal fingers around hose. Attach mating hose to the remaining fitting end.



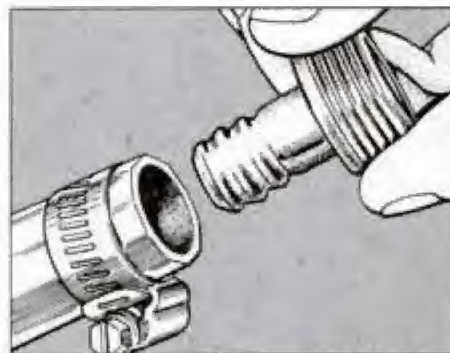
**3** Force ribbed sleeve into hose until collar butts against hose end. If fit is too tight, lubricate sleeve by rubbing it with soap.



**4** After attaching mating hose section, screw plastic clamps to either side of repair. This fitting can be removed and reused.



**5** Clinch-type fittings can replace damaged threaded fittings at hose ends. Here, a brass female fitting is inserted into end.



**6** Here's another fitting that can replace threaded fittings. Slip on hose clamp, insert fitting and tighten clamp with screwdriver.

**H**AS YOUR garden hose sprung a leak? Are the hose fittings damaged or corroded? If so, you don't need a new hose, simply repair the one you have.

Repairs are simple and inexpensive and, hose replacement parts and repair kits are sold at hardware stores, home centers and garden supply shops. However, before we get into the actual repair steps, let's discuss briefly how to avoid damaging a hose in the first place. Don't fold over and pinch the hose to cut off the water, or store it with sharp kinks in it. Be careful not to drive over a hose or strike it with garden tools, especially in cold weather. Don't yank on a hose when it's connected to the sill cock (exterior faucet). You can damage the hose and the threaded fittings. Also, never allow water to freeze in the hose.

## Repairing a damaged hose

First, use a utility knife to cut the hose and remove damaged sections. Try to cut the hose ends as square and straight as possible (Fig. 1). There are two common hose repair kits sold. One is a metal clinch-type, as shown in Fig. 2. The other is a plastic screw-together clamp (Figs. 3 & 4).

To install the 1-piece clinch-type fitting, force the ribbed end of the metal fitting into the hose. If the fit is tight, soak the hose end in hot water. Once the fitting end is pushed into the hose, use pliers to squeeze down the individual metal fingers that surround the hose. Repeat this procedure to attach the mating length of hose to the remaining end of the fitting.

To install a screw-together clamp, first push the ribbed sleeve into the hose end (Fig. 3). If necessary, rub

soap on the fitting to act as a lubricant. Next, push the mating hose length onto the other end. Then, place clamps on each side of the splice and tighten the screws (Fig. 4).

## Replacing a fitting

The threaded brass fittings at the end of a hose must be replaced when damaged. When purchasing a replacement part, be sure to get the right fitting—either male or female.

Metal clinch-type fittings are available for hose ends, too (Fig. 5). Force the fitting into the hose end and use pliers to bend down the metal fingers.

Push-in fittings and small hose clamps can also replace threaded fittings. Slip the hose clamp over the hose and force the replacement fitting into the hose end (Fig. 6). Using a screwdriver, tighten clamp. **PM**



# How To Sharpen A LAWNMOWER BLADE

BY ROSARIO CAPOTOSTO, Contributing Editor; PM Illustrations by George Retseck

**I**N MUCH of the country, March or April signifies the start of the lawnmowing season. And each season should begin with a routine maintenance check of your mower. This annual checkup should include draining the oil and gas tank and refilling with new lubricant and fuel, cleaning the sparkplug, lubricating all moving parts, and sharpening the blade. Here, we discuss how to sharpen a rotary mower blade. To sharpen a reel-type mower, see page 104.

## Sharpening options

There are a few ways to sharpen a mower blade. You can either use a file or a special sharpening stone that mounts in an electric drill. The blade can be sharpened while it's on the mower, or it can be removed for

sharpening at the workbench. I prefer removing the blade. This allows greater control and accuracy.

Before you touch the blade, disconnect the sparkplug wire and tie it away from the sparkplug (Fig. 1). This will eliminate any chance of the mower starting accidentally. Next, tip the mower on its side (do this *before* refilling the crankcase and fuel tank) and scrape away caked-on grass from the underside of the mowing deck (Fig. 2).

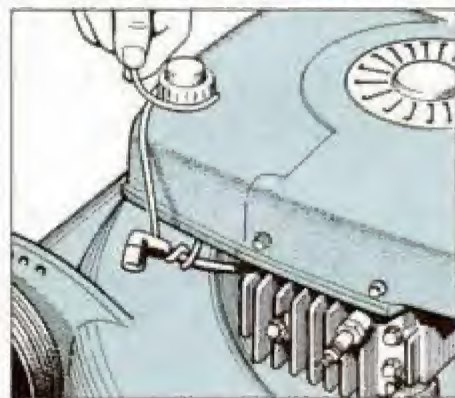
To hone the blade's cutting edges without removing it, use a drill-mounted sharpening stone, as shown in Fig. 3. (Sold in hardware stores.) Start the drill and slowly guide the stone across the edge. Make the same number of passes over each edge, otherwise, the blade will be out of balance.

This drill accessory is fine for hon-

ing a dull blade. However, if a blade is badly nicked or chipped, remove it, reshape the cutting bevels on a bench grinder, and then sharpen the edges.

Using a single-cut bastard file, stroke across the entire cutting edge (Fig. 4). Hold the file at an angle to match the original bevel. Count the strokes made until the edge is sharp. Then, make the same number of strokes on the blade's other edge to ensure that the same amount of metal is removed from both sides.

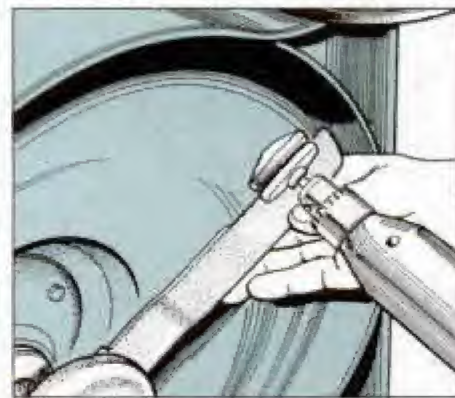
It's very important that a blade is balanced. An out-of-balance blade will vibrate and eventually wear out the bearings or bend the crankshaft. A simple way to test a blade's balance is with a pocket knife, as shown in Fig. 6. If the blade doesn't balance on the knife's edge, file the heavy end. **PM**



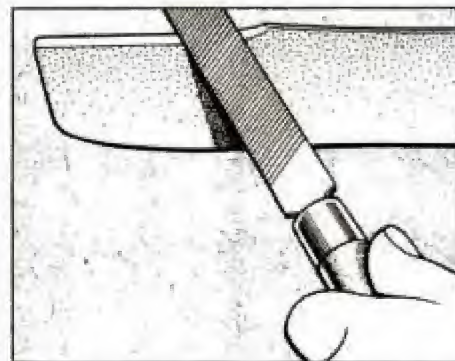
**1** Before touching mower's blade, disconnect sparkplug wire and tie it away from sparkplug to prevent engine from starting.



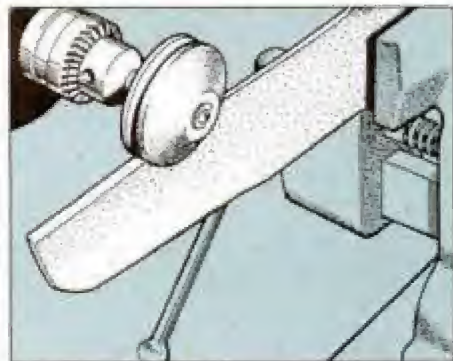
**2** With mower tipped on its side, use a flexible-blade putty knife to scrape matted grass from underside of mowing deck.



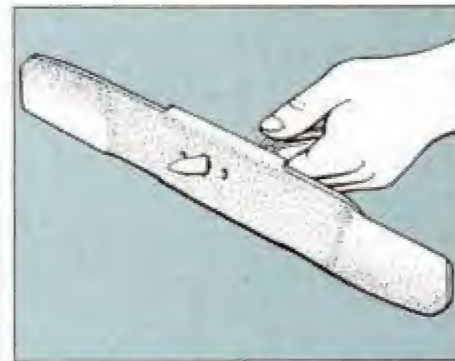
**3** To hone the blade's edges without removing it from the mower, use a special sharpening stone that mounts in a drill.



**4** To file blade sharp, remove blade and clamp in a vise. Stroke across cutting edge. Count strokes and repeat on other edge.



**5** Drill-mounted sharpening stone can be used with blade removed and held in a vise. Guide stone over edges three or four times.



**6** Check balance of blade with a pocket knife. Insert knife through center hole in mower's blade. File heavy end, if needed.



# Homeowners' Clinic

BY NORMAN BECKER, P.E., Contributing Editor

## Hot-Water Odor

I live in an apartment where there is an electric hot-water heater. When showering or washing at the kitchen sink, I detect a foul odor coming from the hot water. I can live with the smell, but I'd like to know what's causing it.

GRAYDON G. WORBY  
SANDWICH, IL

A domestic water heater basically consists of a lined steel tank. The lining is usually vitreous enamel (glass) but can be concrete (stone) or copper. Because the lining may have imperfections and pinholes, most heaters are equipped with a sacrificial magnesium anode rod that's suspended inside the tank to minimize tank corrosion. The electrochemical action that causes corrosion takes place between the water and the anode, rather than between the water and the tank. Therefore, the life of the tank is increased. Some tanks are constructed so that the magnesium anode can be replaced if necessary.

The odor is probably the result of a reaction between the water and the magnesium anode. Water sometimes contains a high sulfate and/or mineral content. These chemicals can react with the anode and produce a hydrogen sulfide or rotten-egg odor in the heated water.

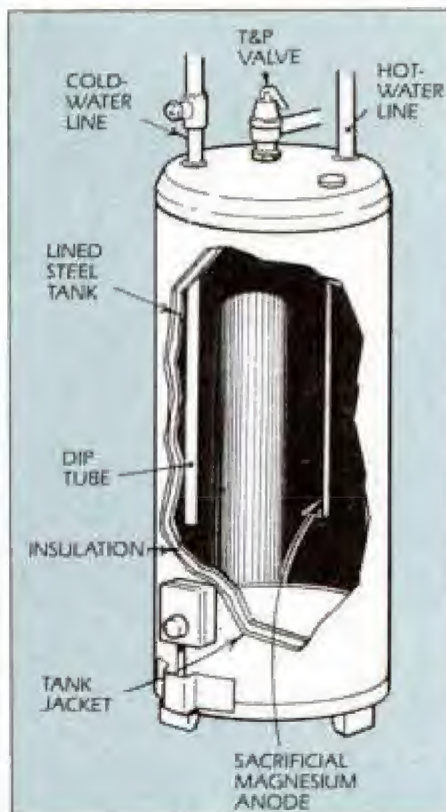
It's also possible that the odor is the result of the action on the anode of certain nonharmful bacteria in the water. In either case, chlorination of the water supply should eliminate or at least minimize the problem.

## Replacement Anodes

I realize that magnesium anodes are installed in water heaters to extend their life. However, replacing them when they corrode away is usually difficult because the headroom above the water heater is generally less than the length of the anode. Do you have any suggestions on how a replacement anode can be installed?

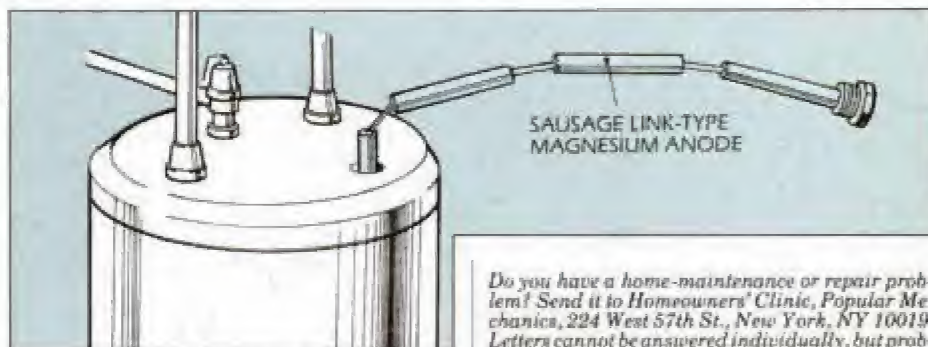
DARREL LEMON  
LONGMONT, CO

*Flexible sausage-link type replacement anodes are available for installation into tanks where the ceiling*



Magnesium anode in water heater extends life of tank. Odor in hot water can result from minerals reacting with magnesium.

clearance is limited. Each anode link is about 12 in. long and there are about four links strung on a wire. The anode string is about 52 in. long and costs about \$45. It can generally be purchased from a plumbing supply company that either has it in stock or will order it from the Rheem Manufacturing Co., 7600 S. Kedzie Ave., Chicago, IL 60652.



Tanks that accept replacement anodes can use link-type anodes where overhead clearance prohibits installing rigid type.

## Defective Formica Surface

Is there any way to repair small defect holes (1/8 in. dia. or less) in a permanently installed Formica pre-formed kitchen countertop? The damage is not the result of cutting or misuse.

RALPH V. HOPPER  
ESTES PARK, CO

*There is no good permanent repair that can be made to the surface of laminates such as Formica, especially for countertop usage. The material is so hard and dense that patching materials such as adhesives and epoxies just won't stick permanently.*

*If the countertop is not very old, then discuss the matter with your local Formica distributor. They will have one of their representatives look at the countertop and evaluate the problem. If it has a manufacturing defect, they will replace it.*

PM

## Service Tip

Each year there are almost 200,000 residential fires in the U.S. that are of electrical origin. These fires result in thousands of deaths and injuries and over a billion dollars in property losses. To help reduce these numbers, the U.S. Consumer Product Safety Commission has published two informative booklets: "Guide To Electrical Safety" and "Home Electrical Safety Audit—Room By Room Checklist." For your free copies, write to the U.S. Consumer Product Safety Commission, Washington, D.C., or call (800) 638-2772.

*Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$2.45 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.*



# Appliance Clinic

BY STEVE TOTH, Contributing Editor

## Belt Installation

My 10-year-old Kenmore Gas Dryer model No. 110.6907510, serial No. 1292M850 needs a new belt. How do I put it on?

CLAUDE V. SWITZER  
LOS ANGELES, CA

First pick up a new belt (part No. 341241) at your local appliance parts store or any Sears repair parts center. It will cost about \$10. Unplug the dryer from its electrical power source, lift the lint screen cover, and remove the screen. Also, remove the two screws under the cover.

Raise the dryer top by inserting a thin-blade putty knife between the top and front panel about 2½ in. in from each corner to release the securing clips. Place a towel over the front edge and lean the top against the wall behind the dryer. You can also use a piece of rope or wire attached to the side panel to keep the top from falling back too far.

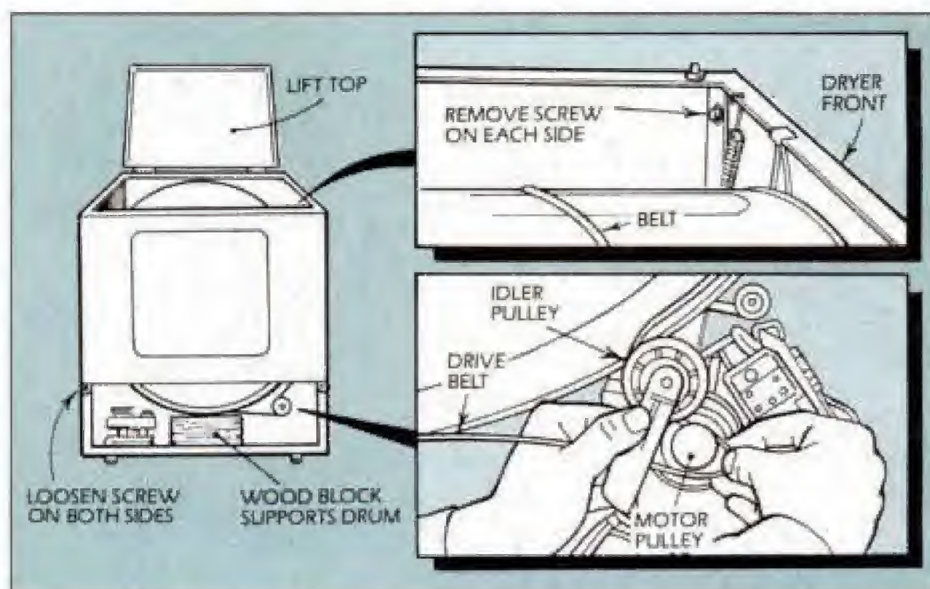
Next, remove the lower access panel by pulling down on the top corners. Loosen the two screws at the upper corners of this opening about 1½ turns. Then, block up the front of the drum with scrap wood.

Remove the two screws on the inside top corners of the front panel so the panel can be moved out a little. The drum may drop slightly at this point. Pull the panel out just far enough to slip the new belt by the panel and over the drum.

Resecure the front panel—you may have to lift the drum slightly—and remove the wood blocking. Make sure that the rear drum seal fits properly over the lip on the bulkhead.

Remove the old belt from the idler and motor pulley. After it's loose, cut it with wire-cutting pliers or scissors and pull it out. Route the new belt under the idler pulley, push the idler pulley toward the motor pulley, and slip the belt over the motor pulley.

Retighten all screws. Before securing the lower access panel, vacuum any dust in the bottom of the dryer. Then, attach the panel. Lower the top and press it in place to engage the clips. Reinstall the two screws that hold the lint chute and install the lint screen and cover.



To install belt on Kenmore dryer, first lift top, remove lower panel and block drum. Then, loosen front panel and slip belt in place. Cut away old belt and thread new belt around pulleys.

## Ice-Age Frost-Free

I own a Montgomery Ward refrigerator model No. UFO 1753-02A, serial No. 37B48772. It shuts off periodically because ice forms under the freezer base locking the fan and not allowing the water to run out. If I leave the unit unplugged overnight, it will start again. The repairman says that there's nothing in the manual to cover this. Any ideas?

GLENDON C. HUGHES  
MANSFIELD, OH

You can install a heater kit that's designed to eliminate ice formation in the fan housing. It's Montgomery Ward part No. 69-408001 and costs about \$25. It can be ordered from the Montgomery Ward national parts center by calling (800) 323-1965.

If your repairman would like information about this heater kit, have him check the Montgomery Ward service letter No. 69-1563, dated 1/30/84.

## Stove Questions

My Hotpoint electric wall oven model No. 30RJ36, serial No. AK-576 needs a new oven door gasket. Where can I get a gasket and instructions?

JOSEPH C. POTILLO  
PINE BLUFF, AR

First contact the General Electric answer center at (800) 626-2000 and get the name and address of the nearest factory parts distributor. The door gasket is part No. 2X5103 and costs about \$20.

The two lower gaskets that fit along the bottom of the oven cavity are part No. WB2X5084. They cost about \$1.50 each.

To install the gaskets, first disconnect the power supply and remove the screws that hold the oven to the wall. Lay an old blanket on the floor and have someone help you lift the oven out and set it on the blanket.

Remove the rear access panel from the oven. You'll see two springs approximately 1 in. in dia. hooked into tabs on the oven liner and attached to the rear frame. These springs hold the liner in place. Grasp one spring at a time with locking pliers and release them from the tabs.

Open the door and pull out the liner about ¼ to ½ in., remove the old gasket, and slip the new gasket in place. Gently push the liner back into the frame. Rehook the springs, close the door and reinstall the oven. **PM**

If you have a problem with any appliance, send your question, along with model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.



SPECIAL SECTION

# SPORT/UTILITY



## A PM GUIDE TO LIFE WHERE THE PAVEMENT ENDS

- |                                    |                                   |
|------------------------------------|-----------------------------------|
| ■ <b>FOURS FOR FUN</b> 111         | ■ <b>POUNDS OF PREVENTION</b> 128 |
| Which 4wd system is right for you? | A get-it-home-again survival kit. |
| ■ <b>DIRT RODS</b> 113             | ■ <b>DIRTY DRIVING</b> 130        |
| Hot compacts duel in the desert.   | Off-road tips from a master.      |
| ■ <b>INTRUDERS IN THE DUST</b> 122 |                                   |
| A look at the newest utes.         |                                   |



# Ticket to Ride.

"Dad talks in smokescreens. Can't ever say what he really feels. Like this morning, getting ready to go. All he could talk about was the truck. Did I have the oil checked? How were the brakes? So I told him, I had the Goodwrench guys at the GM dealership look it over.

I did, too.

See, this truck is my ticket to the real world. My freedom to go where I want to go. You better believe I'm gonna take care of it.

Dad just nodded.

But I knew what he was saying."

Your truck is an important part of everything you do, whether it's hauling bales of hay or striking out on your own. That's why it's important to take it to Mr. Goodwrench.

No one else has the GM factory training, the experience, the genuine GM parts that Mr. Goodwrench has. That goes for GM cars as well as trucks.

So whether you drive a Chevrolet, Pontiac, Oldsmobile, Buick, Cadillac or GMC

Truck, bring it to Mr. Goodwrench.

You'll find him at over 7200 General Motors dealerships coast to coast.



Mr. Goodwrench

It's not just a truck... it's your freedom.

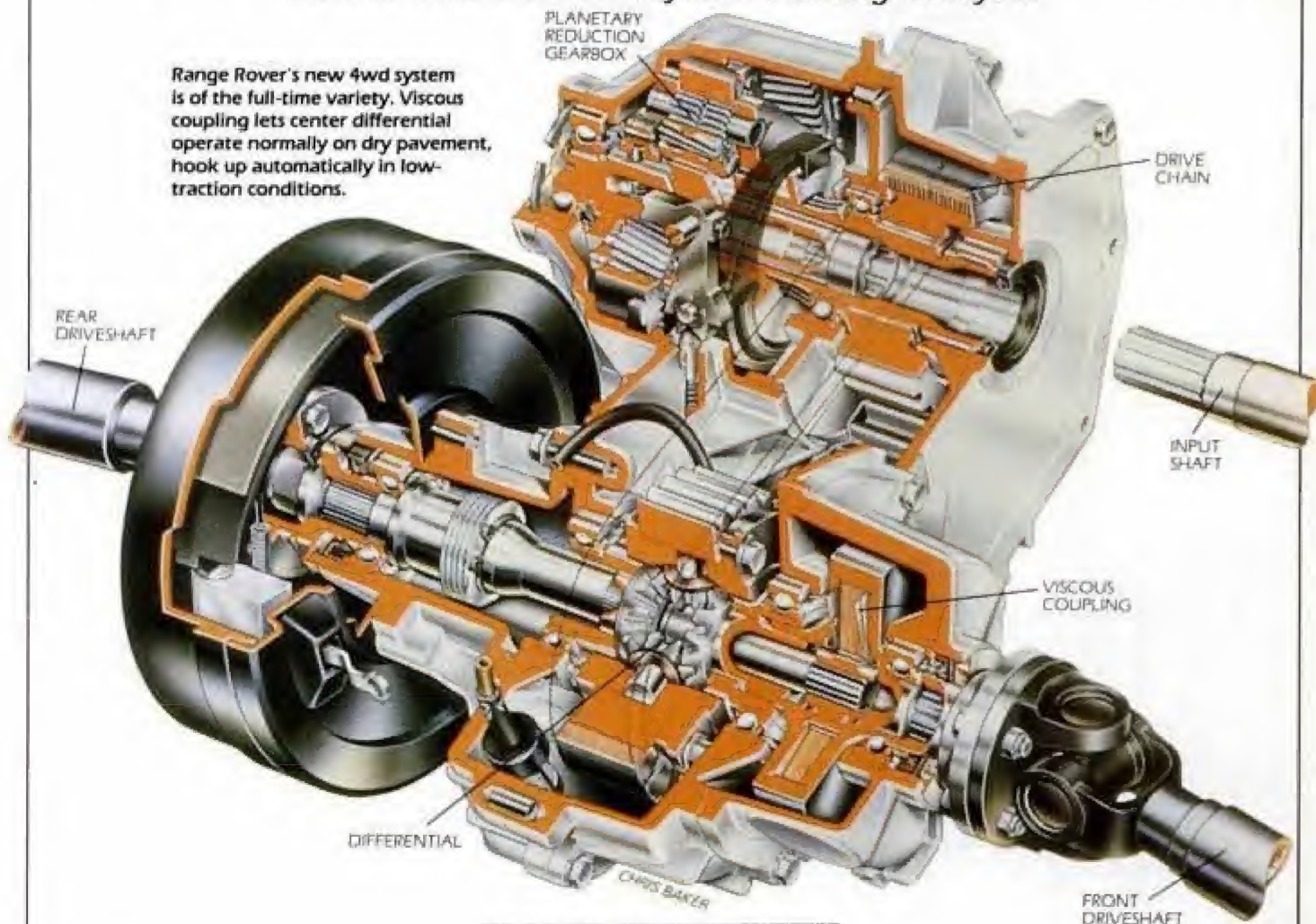




# FOUR FOR FUN

How to choose the 4wd system that's right for you.

Range Rover's new 4wd system is of the full-time variety. Viscous coupling lets center differential operate normally on dry pavement, hook up automatically in low-traction conditions.



BY PAUL VAN VALKENBURG

**L**ET'S SAY you've narrowed your choice down to two different 4wd vehicles, based on the usual criteria like performance, appearance and cost. But it turns out they have two totally different drivelines, according to the sales descriptions. How do you decide? It's seldom an either-or decision. You don't simply buy or not buy 4wd—you have to *comprehend* it. So let's try to illuminate the dark areas.

First, what are your needs—when would 4wd be helpful, and when would it be mandatory as a survival necessity? That depends on three more specific questions: your personal skills, your environment and how you trade off the cost/convenience factor. Are you a skilled driver/mechanic, reading this just out of idle curiosity, or are you searching in des-

peration for some familiar phrases that might explain what is going on inside? The former knows how to avoid most traction problems and how to get out of others without 4wd, while the latter doesn't usually read PM. Somewhere in between? Okay, go on to question two: How many places do you drive where you are actually exposed to traction problems, and how serious are they?

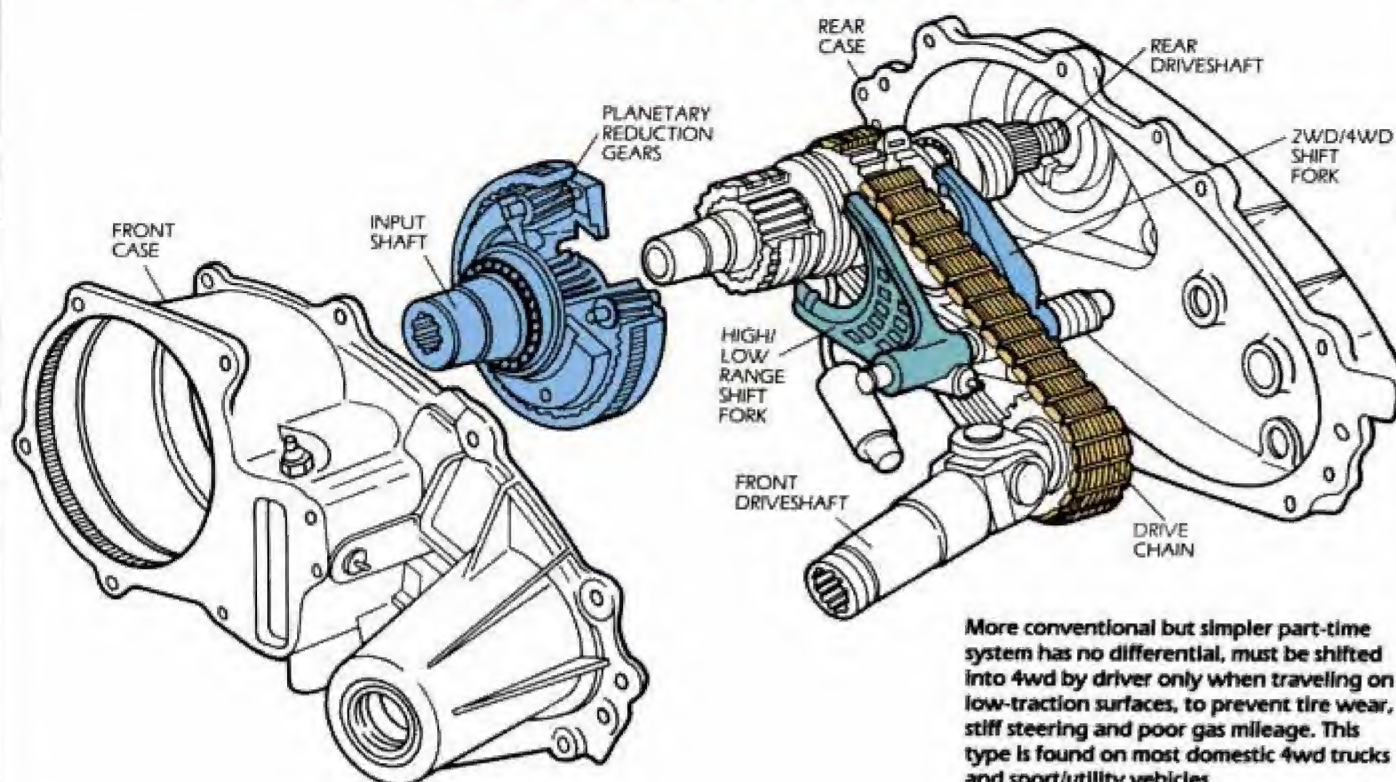
Frequent heavy snows. Muddy rural roads, weekend desert treks, occasional ski trips, the rare greasy-wet freeway, or are you just expecting to have a problem on your vacation next summer? And that leads to question three: What is it all worth to you? How many times have you actually been so securely stuck that it took a tow to get out, or how many times have you avoided going somewhere

when you *thought* you might get stuck? Something else to consider: You might be able to pay for a lot of tows with what some systems cost, but it may be hard to buy back lost hours or lost opportunities.

## The categories:

■ **Part-Time 4wd** is basically the simplest to produce and least expensive to buy, but conversely it requires the most awareness to use. "Part time" is a euphemism meaning you can't (or shouldn't) use it *all* the time. It doesn't include a center differential which would allow the front and rear wheels to rotate at different speeds. In other words, turning a corner while it is engaged puts a strain on the driveline as the front wheels take a shorter path—and a strain on you at the steering wheel to make it turn.





More conventional but simpler part-time system has no differential, must be shifted into 4wd by driver only when traveling on low-traction surfaces, to prevent tire wear, stiff steering and poor gas mileage. This type is found on most domestic 4wd trucks and sport/utility vehicles.

The lack of a center differential also causes extra tire scrub in a straight line on pavement, since front/rear tire diameters are rarely exactly equal. Part-time systems are best for low-cost occasional use by experienced users, or in racing, where it does provide great straight-line off-road stability at high speed.

■ **Full-Time/All-The-Time 4wd** is the other extreme. A person should be able to drive it for years without even knowing it's there.

However, it does require greater hardware sophistication, and in theory at least, it wastes more fuel and power, since all those extra components have to be carried around for 99 percent of the time when they aren't needed. Full-time 4wd systems are best for the totally unaware owner who lives in an ugly climate, and where cost is no object.

■ **Full-Time On-Demand Manual-Control 4wd** is a compromise that could be left permanently in 4wd or 2wd if you so desired. This is most common, as it provides the center differential, but with an in-out control that allows you to decide when to save wear and tear over long periods of non-4wd use. Best for average awareness, or vehicles that are employed for a wide range of uses like commuting, long trips and the occasional non-sticky situation.

■ **Full-Time On-Demand Automatic 4wd** is a combination of all-the-time and on-demand, as a viscous coupling

or some sort of limited-slip differential is used between the front and rear axles, so that you don't have to decide whether or when to engage 4wd. If the primary drive wheels start to spin, the other end starts to drive.

#### Possible added features and options:

■ **Hi/Lo Range** is commonly available for serious off-road utility use. Functionally, what it provides is a lower gear ratio for really severe pulling problems on high-traction surfaces, or extended very low-speed pulling that might otherwise require destructive clutch slippage. It's irrelevant on low-traction surfaces like slippery pavement.

■ **Limited-Slip Differentials** (or locking diffs, or antispin or Positraction) are often an option at one or more of the two or three differentials. The two most common types are the friction plate clutch and the newer viscous coupling, both working essentially the same except that the latter may be slightly smoother and more durable under continuous stress. The most common location is at the rear axle, although one may be available at the center differential.

■ **Unlocking Front Hubs** allow you to disconnect the front driveline at the wheels in addition to shifting out of 4wd at the transfer case. This reduces rotating drag and/or excessive wear of those components. Originally only manual operation was available,

meaning you had to stop, get out, kneel in the mud and turn each one by hand. Now automatic hubs are frequently available, which only require you to shift to 2wd and back up the vehicle to disengage them, and they will automatically engage on-the-fly when you shift into 4wd.

#### Decisions, decisions

It all becomes simple if you live at the extremes, like the local doctor who makes house calls in rural Minnesota. He is probably unfamiliar with the mechanical particulars of 4wd and is not a terribly skilled driver. Nevertheless, he has many situations where getting there is literally a life-or-death matter and cost is no object.

At the other extreme is the urban Arizona outdoorsman. He doesn't find many traction problems and when he does, he could probably drive out of most of them with 2wd and an open differential.

On top of that, he's not gonna let some silly fuse or computer tell him he can't shift into 4wd when his boat trailer starts pulling him down a muddy riverbank—he just bangs it in gear. Anybody's part-time system is good enough.

Everyone else who lives in the gray area between the extremes is going to have to sit down with the above list and make independent decisions option by option, price by price. What would we choose? Don't ask us—we get 'em all, remember?

PM



SPORT/UTILITY

# DIRT RODS

An expert torture test for the cream of the compact SUV crop.

BY RICH TAYLOR, Contributing Editor, with ROD MILLEN; PM Photos by Ron Hussey



FORD BRONCO II

**Y**OU KNOW Rod Millen. He's been racing Mazda products for 15 years, first in his native New Zealand and then from his shop in Huntington Beach, California. In 1988 alone, he won the SCCA Pro Rally National Championship for the second time, raced up Pike's Peak in a 600-hp RX-7 and nearly won the stadium truck championship, even though he sat out half the season.

See the pattern? Right. Rod Millen is one of the best racing drivers in this country—one of the best in the world—when the surface turns to dirt. Mud. Sand. Gravel. Any place you can get sideways, crossed up and

airborne. So Rod was a natural choice to help us evaluate the latest crop of 4x4 sport/utility vehicles, the ones with big 6-cylinder engines, off-road suspensions and tires up to here.

We spent two terrific days jumping and sliding trucks for the photographers, then more time doing performance testing at Los Angeles County Raceway. We even put in some long hours on the freeway, all the way from L.A. to Baker, California, in search of the perfect dune. We—and Rod—have a lot of miles on these 4x4s under a wide variety of conditions. Remarkably, not one of them broke down, got stuck or even



looked like they were getting out of breath. These trucks are fast, they're fun, they're tough. That's why we call them Dirt Rods.

## Nissan Pathfinder SE V6

Our favorite Dirt Rod is Nissan's clever Pathfinder. It's stylish, comfortable and strong. Rod likes it a lot. As he says, "The seats are very comfortable and the layout of the steering and instruments is very practical. I love the double trip odometers. The gearshift and transfer case shifter are easy to use and convenient. Quality seems very good, and the interior is quite modern and attractive. It's up to date. You could say that about the exterior styling, too. Overall, this is a great package.

"Handling is nice and firm, with no excessive body roll. It has, by far, the widest tires in this group (General Grabber AP 31x10.5/OR15 LT M+S) which help it



TOYOTA 4RUNNER

perform the best off-road. But these wide truck tires are definitely no drawback on the pavement. They are high-profile, rather than low-profile, so you get some sidewall flex which actually acts to smooth out the ride. For this type of vehicle, the suspension is a perfect compromise between on-road and off-road."

Millen has only one complaint with the Nissan, and it's one every driver in our group remarked about. Even though the Pathfinder shares its 3.0-liter V6 with the 300ZX sports car, it's bog slow in acceleration. Indeed, it was the slowest in this group and one of the slowest accelerating vehicles we've ever tested. The culprit is weight. At 3800 pounds, the little Pathfinder weighs as much as an S-class Mercedes-Benz. The

## DODGE RAIDER



MITSUBISHI MONTERO



GMC S-15 JIMMY



JEEP CHEROKEE



CHEVY S-10 BLAZER

## SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/ MODEL	PRICE: LIST/ AS TESTED	ENGINE/ DISPLACEMENT (ci/cc)	ENGINE HP, NET/ TORQUE (lb.-ft.)	ENGINE/ DRIVE LAYOUT	TRANS- MISSION TYPE	WHEEL- BASE (in./mm)	LENGTH OVERALL (in./mm)	WIDTH OVERALL (in./mm)	TRACK FRONT/REAR (in./mm)
<b>Chevrolet S-10 Blazer</b>	\$13,255/ \$18,821	V6, OHV 262/4295	160 @ 4000 rpm/ 230 @ 2800 rpm	front- rear/4wd	4-speed auto	100.5/ 2551	170.3/ 4324	65.4/ 1660	F:54.1/1373 R:54.1/1373
<b>Dodge Raider</b>	\$12,550/ \$16,910	V6, SOHC 181/2972	143 @ 5000 rpm/ 168 @ 2500 rpm	front- rear/4wd	5-speed manual	92.5/ 2348	154.9/ 3932	66.1/ 1678	F:55.1/1398 R:54.1/1373
<b>Ford Bronco II</b>	\$13,915/ \$18,673	V6, OHV 179/2933	140 @ 4600 rpm/ 170 @ 2600 rpm	front- rear/4wd	5-speed manual	94.0/ 2386	161.9/ 4110	68.0/ 1726	F:56.9/1444 R:56.9/1444
<b>GMC S-15 Jimmy</b>	\$13,313/ \$19,127	V6, OHV 262/4295	160 @ 4000 rpm/ 230 @ 2800 rpm	front- rear/4wd	4-speed auto	100.5/ 2551	170.3/ 4324	65.4/ 1660	F:54.1/1373 R:54.1/1373
<b>Jeep Cherokee</b>	\$23,153/ \$24,889	L6, OHV 241.7/3962	177 @ 4500 rpm/ 224 @ 2500 rpm	front- rear/4wd	4-speed auto	101.4/ 2574	165.3/ 4196	69.3/ 1759	F:57.0/1447 R:57.0/1447
<b>Mitsubishi Montero</b>	\$13,949/ \$15,885	V6, SOHC 181/2972	143 @ 5000 rpm/ 168 @ 2500 rpm	front- rear/4wd	5-speed manual	92.5/ 2348	154.9/ 3932	66.1/ 1678	F:55.1/1398 R:54.1/1373
<b>Nissan Pathfinder</b>	\$15,399/ \$18,304	V6, SOHC 181/2960	145 @ 4800 rpm/ 166 @ 2800 rpm	front- rear/4wd	5-speed manual	104.3/ 2648	171.9/ 4364	66.5/ 1688	F:56.9/1444 R:56.3/1429
<b>Toyota 4Runner</b>	\$17,128/ \$20,982	V6, SOHC 181/2958	150 @ 4800 rpm/ 180 @ 3400 rpm	front- rear/4wd	5-speed manual	103.3/ 2622	174.8/ 4438	66.5/ 1688	F:56.3/1429 R:55.5/1409

1. Best speed achieved while weaving through seven cones placed in-line, 100 ft. apart; speeds provide index of transient response.



Pathfinder doesn't need anything but more horsepower. But it needs that a lot.

## Jeep Cherokee Limited

We like the Cherokee, and so does Rod. Indeed, he almost selected it first over the Pathfinder. The luxurious leather-upholstered Cherokee is actually more convenient for everyday driving, but the Pathfinder is a better all-around performer when the going gets rough. Realistically, for the way most families use their 4x4s, the Cherokee could be a better choice. However, Rod did have some complaints.

"The first thing that's apparent is that the steering is too sensitive," complains Rod. "It's got too much power assist. The wheel is also positioned too close to me, and I can't get farther away. The Cherokee feels nice and stable on the road, but that's probably because the tires are street tires, not all-terrain tires (Goodyear Eagle GT+4, P225/70R15 M+S). As soon as you get off the pavement, these tires don't perform at all.

"The dash layout includes everything, but the instruments and controls are just a humble-jumble. The seats are too small, with not enough thigh support. The leather seats are not practical for off-roading, but then few Limiteds will ever be seen off-road, I expect. The exterior styling is pleasant enough, chunky and solid-looking, though certainly not as modern as the Pathfinder. The engine feels strong, and made the Cherokee the



CHEVY S-10 BLAZER

quickest and fastest vehicle in the test. But the Limited is not a man's vehicle. It's more like something your wife would drive to the market. It's a replacement for the traditional station wagon. More serious off-roading would call for a Cherokee without the Limited option. There's a surprising amount of wind noise from around the windshield, plus some loud tire and road noise. The engineers might do some work on Noise/Vibration/Harshness. For \$25,000, you deserve more attention to detail."

## Toyota 4Runner SR-5 V6

"This has a very different feel from something like the Pathfinder," says Rod. "It doesn't feel as stable when



NISSAN PATHFINDER



FORD BRONCO II



TOYOTA 4RUNNER



DODGE RAIDER

## TEST RESULTS

CURB WEIGHT (lbs.)	STEERING TYPE/TURNS LOCK-TO-LOCK	BRAKE SYSTEM FRONT/REAR	FUEL ECONOMY (EPA city/PM test)	ACCELERATION 0-60 MPH (sec.) 1/4-MILE (sec. @ mph)	BRAKING 60-0 MPH (ft.)	700-FT. <sup>1</sup> SLALOM (hard-packed dirt)
3200	power recirculating ball/3.5	F:10.5-in. vented disc/ R:9.5-in. drum, ABS	17/16.9	13.64 18.06 @ 74.01	165	48.82 mph
3550	power recirculating ball/3.4	F:10.1-in. vented disc/ R:10.0-in. drum	15/17.5	12.46 17.17 @ 76.51	135	53.70 mph
3400	power recirculating ball/3.5	F:10.8-in. vented disc/ R:9.0-in. drum, ABS	16/18.2	12.51 17.42 @ 77.34	136	52.47 mph
3200	power recirculating ball/3.5	F:10.5-in. vented disc/ R:9.5-in. drum, ABS	17/16.9	13.31 17.83 @ 74.73	159	53.89 mph
3150	power recirculating ball/3.5	F:11.0-in. vented disc/ R:10.0-in. drum, ABS	16/16.5	12.14 17.08 @ 77.99	141	53.53 mph
3550	power recirculating ball/3.4	F:10.1-in. vented disc/ R:10.0-in. drum	15/17.4	12.29 17.12 @ 77.28	132	53.34 mph
3800	power recirculating ball/3.0	F:10.2-in. vented disc/ R:10.0-in. drum	14/16.9	14.24 18.37 @ 72.30	143	50.68 mph
3850	power recirculating ball/3.6	F:10.0-in. vented disc/ R:10.0-in. drum	15/17.2	13.34 17.75 @ 74.25	122	52.70 mph



you're driving it. The tires (Dunlop ST Qualifier P225/75R15 M+S) are too narrow for off-roading—they bog down in sand, for example—and not particularly well-suited for tight cornering on hard pavement. It's a bit peppier than the Pathfinder, even though it weighs a bit more, but it still doesn't have enough horsepower."

What the 4Runner does have is every possible gizmo: a moonroof, an adjustable steering wheel, cruise control, a fancy radio, a power-operated tailgate window, extremely comfortable bucket seats with a wide range of adjustments. The rear seat thoughtfully splits, so you can carry both skis and a back seat passenger. You pay for all this comfort and convenience, though.

At \$21,000, the 4Runner is the second most expensive vehicle in this test, right behind the equally optioned-up Cherokee Limited.

Even though Toyota's Pickup is all-new for 1989, the 4Runner is still built off the previous Pickup chassis/body, though a mid-'89 update is due. We hope Toyota preserves one handy feature. Unlike any of the competition, the 4Runner has a removable roof over the rear seats and cargo area. The roof must be unbolted and stored at home, and it's too heavy for one person to easily remove. On the other hand, there are times when unlimited headroom—and fresh air—is worth a little inconvenience.

### Chevy S-10 Blazer Sport And GMC S-15 Jimmy Gypsy

Like many GM vehicles, this 4x4 is sold by two different divisions, with only the name on the hood to tell them apart. Both our Blazer and Jimmy are



GMC S-15 JIMMY

equipped with the new 4.3-liter V6—essentially, three-quarters of the 5.7-liter 350 V8—and frankly, we're disappointed at the lack of engine performance. If we'd only had one of them, we would have assumed it was an individual aberration. But they performed within tenths of each other, so this is probably a representative sampling.

Says Rod, "I must say that I expected a lot more acceleration from a 4.3-liter engine, the largest in this group. It has good low-speed torque, but it runs out of breath very quickly. The chassis feels very loose. There's an uncomfortable pitch/yaw motion, and the suspension needs to be stiffened to cut down body roll.

"Perhaps it's the tires (Uniroyal Laredo P235/75R15 M+S), but when you drive fast, it has quite a bit of understeer. Stiffer sway bars would definitely help. The ride is nice and smooth on smooth roads, but it falls to pieces on the rough stuff.

"I don't much fancy the digital instruments. The dash they used to have, the one with six round analog gauges, was much easier to read. The

seats offer very little support. For off-roading, you need more supportive seats than you do for cruising down the freeway.

"The interior is nicely styled, I think, but the ergonomics are not well thought out. If you play with all the buttons long enough, you'll figure out what they do, but they are not logically arranged."

### Ford Bronco II Eddie Bauer Edition

As with all the other vehicles in our test, Rod had likes and dislikes about the Ford Bronco II.

"The engine feels strong with lots of midrange torque, the styling is pleasantly boxy and it seems well put together. They really do need to do a complete rethink on the interior and suspension, though."

As he says, "Steering wheel: too high. Seats: not enough support. Eddie Bauer interior trim: fuzzy velour, not macho enough for off-roading [it's optional; you don't have to order it]. The six white-on-black instruments are readable, but the ergonomics as a whole are not good. I don't like the electronic pushbutton control for the 4-wheel drive, and I don't like having to rock back in Reverse to disengage it. I'd rather have a mechanical lever sticking out of the floor, even if it is in the way sometimes.

"The whole vehicle sits very high off the ground, and it feels like it has a high center of gravity. The suspension is too soft, both in the shocks and swaybars. It rolls around a lot, even on smooth pavement, and the short wheelbase makes it a handful. The tires (Firestone FR480 P205/75R15 M+S) are too short and narrow for off-road use and not very sticky on pavement."

These are similar to statements that Ford engineers will make regarding the Bronco II if you get them in a room and turn off the tape record-



JEEP CHEROKEE



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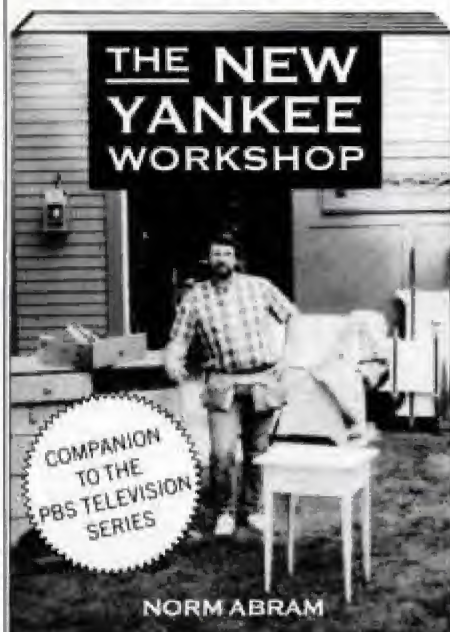
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## SPORT/UTILITY

ers, although Ford is justifiably proud of the construction quality of the current vehicle. Meanwhile, a new Bronco II is being developed which, we're told, will be more competitive in the chassis department.

### Dodge Raider V6 And Mitsubishi Montero Sport

Rod Millen's least favorite Dirt Rod is the Japanese-built Montero, also sold by Dodge dealers as the Raider. The rest of us like it better, finding it cute, well built and sporty. According to Millen, the Montero is "better suited as a work vehicle for a farmer." The rest of us think that it's ready to play, and gives a surprisingly good account of itself in rough going.

We all agreed, though, that the best part of the Montero/Raider is Mitsubishi's excellent 3.0-liter V6, available for SUV applications this year for the first time. As Rod says, "The engine performance is very good, right throughout its rev range. It feels strong and smooth.

"I like the sprung driver's seat for off-roading. That's a very clever feature, and you can lock it down for on-road driving. The dash layout is good, very practical, and you can find everything you need. Overall fit and finish is very good, among the best, and the Montero seems very well-built.

"There's much more wind noise than in, say, the Pathfinder, because the windshield is more vertical and creates more resistance. There's also considerable tire noise, which may be caused by these particular tires (Michelin XCH4 P235/75R15 M+S). The tires do a good job both on- and off-road, but the ride is very harsh because the wheelbase is very short. Even in the front seats, you're sitting almost over the rear axle. You feel ev-

ery jolt. This is a vehicle that seems to be best suited for work around a farm or ranch where the short wheelbase, high ground clearance and sturdy construction would be an asset."

### Conclusion

We had a great time driving these Dirt Rods, from screaming down desert highways to cutting doughnuts at dusk on El Mirage dry lake. We also had a great time with Rod Millen, who's as delightful and knowledgeable a racing driver as you'd ever want to meet.

One thing we were reminded of as we wrapped up this comparison test is that the way a vehicle is optioned out will make a dramatic impression on the way the vehicle will perform. For instance, you can buy a non-Eddie Bauer Bronco II without the velour upholstery and order tires better suited to dirt driving, particularly desert driving, which is likely to include deep sand. While heavy-duty suspension packages are obviously important for bringing out the best in a serious off-road vehicle, tire selection is critical. The right tire, chosen on a basis of how the vehicle will be used and what kinds of terrain it's going to cover, can make the difference between off-road fun and off-road problems.

Similarly, look carefully at the equipment list. The things that made our Cherokee pleasurable on pavement hampered it in our dirt testing. The Cherokee can be ordered in trim levels that don't include amenities like leather, and we feel certain that Rod Millen, a no-frills kind of guy in the dirt, would like a real desert Jeep more.

Each of our Dirt Rods has its strengths and weaknesses. But each can be optimized by careful ordering. When you buy a sport/utility vehicle, be sure to spec it out to *your* needs. **PM**





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SPORT/UTILITY



# INTRUDERS IN THE DUST

More new ways to ride in the rough.

BY BRUCE W. SMITH

**A**LREADY THE hottest segment of the entire automotive industry, the burgeoning sport/utility market

continues to expand for 1989 as light-duty truck manufacturers offer new products and technological updates.

Leading the way for '89 is Isuzu,

which adds a new dimension to the sport/utility market with the Amigo, a 2+2 truck with a split hardtop/soft-top—a first in the market.

Isuzu's Amigo emphasizes the serious sport side of the market and adds something fresh to the styling of 4-wheel drives.

The Amigo's innovative bodywork rides atop the same basic rolling chassis and drivetrain as Isuzu's flagship sport/utility 2-door Trooper II, giving it a 91.7-in. wheelbase and a full 8 in. of ground clearance. However, the Amigo also sports a 3-in. wider track and nearly 10-in. lower overall height, for a very aggressive look when equipped with the optional 31x10.50 light truck tires.

A sturdy 6-crossmember box-ladder frame is the base platform for both the 2wd and 4wd models. Suspension consists of double wishbones



GEO TRACKER/SUZUKI SIDEKICK

PHOTO BY BRUCE W. SMITH



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## SPORT/UTILITY

front and a semi-elliptic leaf-sprung live axle in the rear, à la the Trooper IIs. Yet despite the similarities, the Amigo is almost 300 pounds lighter.

The 4wd Amigos also share the Trooper's I-TEC (Isuzu Total Engine Control) 2.6-liter 4-cylinder engine, which produces 120 horsepower at 5000 rpm and a torque output of 146 lb.-ft. at 2600, while 2wd versions will have the 96-hp 2.3 liter as basic equipment, with the 2.6 as an option.

Initially, all Amigos will be offered with a 5-speed manual. Ventilated power discs front and rear are also standard. Isuzu has also made changes in gearing to accommodate larger tires.

Seating capacity in base trim level, like many other sport/utilities, is designed for two, but can be expanded to accommodate four. Where Isuzu departs in styling is in the roof configuration. Unlike any other SUV, the Amigo comes with the rear cargo/passenger seating area enclosed beneath a vinyl/canvas convertible-style top that snaps on and off as needed, while the driver's area is fully enclosed in a conventional manner.

Amigo pricing is expected to start at just under \$9000 and top at about \$15,000 for the highline 4x4.

Isuzu may have broken new ground in the midsize sport/utilities, but a joint-venture between GM and Suzuki has already lived up the micro class with the Geo Tracker and its badge-engineered twin, the Suzuki Sidekick. Neither is a Samurai derivative. The Sidekick/Tracker was designed by General Motors engineers and built by Suzuki of Japan.

While the ultrashort wheelbase Samurai's suspension is based on live axles and leaf springs, the Tracker/Sidekick duo soak up road shock with a more sophisticated independent front suspension (IFS) system up front and a coil-suspended live-axle in the rear. They also sport a longer (by 7 in.) wheelbase and a wider (by 3 in.) track than the Samurai, substantially improving ride and handling. Interior leg and headroom, for both front and rear seat occupants, is much greater than that of the Samurai, too.

Performance in these mini 4-wheel drives comes from an 80-hp fuel-injected 1.6-liter Suzuki-built aluminum-block Four. The base-model Suzuki Sidekick JA comes with a carbureted 1.3-liter, 64-hp engine like the Samurai. These fuel miserly engines are EPA-rated at 28 mpg city, 29 highway when backed with the standard 5-speed manual.

Not to be outdone by the compact and midsize newcomers, two luxo 4-





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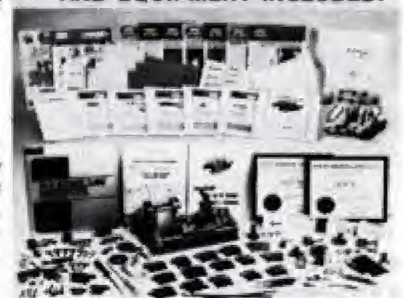
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wheel-drive manufacturers, Range Rover and newcomer LaForza, are introducing new products and advancements to their full-size SUVs.

Range Rover has added more muscle to last year's 150-hp 3.5-liter aluminum V8 by boring it out to 3.9 liters, increasing horsepower to 178. Torque is up, too, from 195 lb.-ft to 220 lb.-ft.

But the bigger engine is just one of Rover's technological improvements. A more significant upgrade is the elimination of the manual differential locking system and the revamping of the transfer case, the latter accomplished by replacing the sliding-sleeve gearset with a Morse chain-and-sprocket drive system.

Drivers of new Range Rovers will no longer have to manually lock the center differential to compensate for wheelspin. Instead, a viscous coupling unit (VCU) has been splined to the center differential, automatically compensating for front/rear disparities in wheel rotation. Range Rover is the only sport/utility to offer it.

On the other side of the luxo-market is LaForza Automobiles, a brand-new company that is introducing a

limited number of luxu-utes called, appropriately, LaForza.

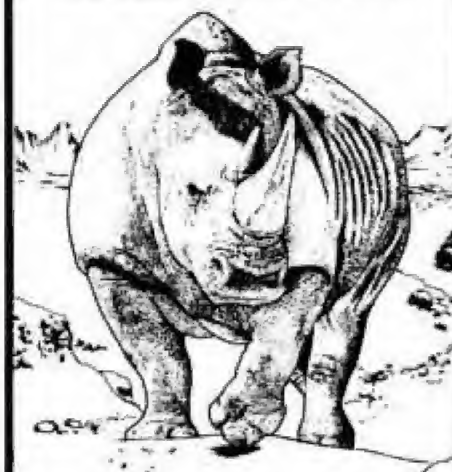
LaForzas are very similar in size and configuration to Ford's full-size Bronco. They are also powered by Ford's 185-hp 5.0-liter V8, with Ford's 4-speed automatic. However, the LaForza's rolling chassis, body and interior are a product of Italian coachbuilder Pininfarina.

It's a brute of an SUV, weighing in at 5082 pounds and delivering a tow rating of 8000 pounds. The suspension, which is anchored to a 2-ton box-ladder truck chassis and Bilstein high-pressure gas shocks, features a military design IFS in front and a full-floating beam axle supported by leaf springs in the rear. Wheelbase is 179.9 in. with a track of 67.8—both very close to the Bronco.

Another impressive aspect of this leather-lined machomobile is its agility. Equipped with rack and pinion steering, the LaForza can turn around in a 30-ft. circle, something even many minicars can't manage. It also comes with limited-slip differentials front and rear, power everything and a price tag of \$43,850. **PM**



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**SPORT/UTILITY**

# POUNDS OF PREVENTION

How to make sure you and your rig make it home again.

BY BRUCE W. SMITH

**P**ICKUP and sport/utility owners who venture off the beaten path—whether it's a one-time outing or everyday occurrence—should give as much thought to preparing their vehicle for outdoor emergencies as they do to stocking the home medicine cabinet. It's really not an exaggeration to say that lives could depend on it. Getting caught out in the boondocks without at least a very basic off-roader "medicine cabinet," could mean spending a lot more time

than you planned in a potentially hostile environment.

So what should be in the off-roader's medicine cabinet? Not as much as you might think. We've compiled a very basic list of behind-the-seat items that can help to deal with minor emergencies and prevent an enjoyable off-road excursion from becoming a nightmare. With any luck, you'll never have to use them. But not having them is inviting trouble.

■ **First-aid kit**—Can be made up at

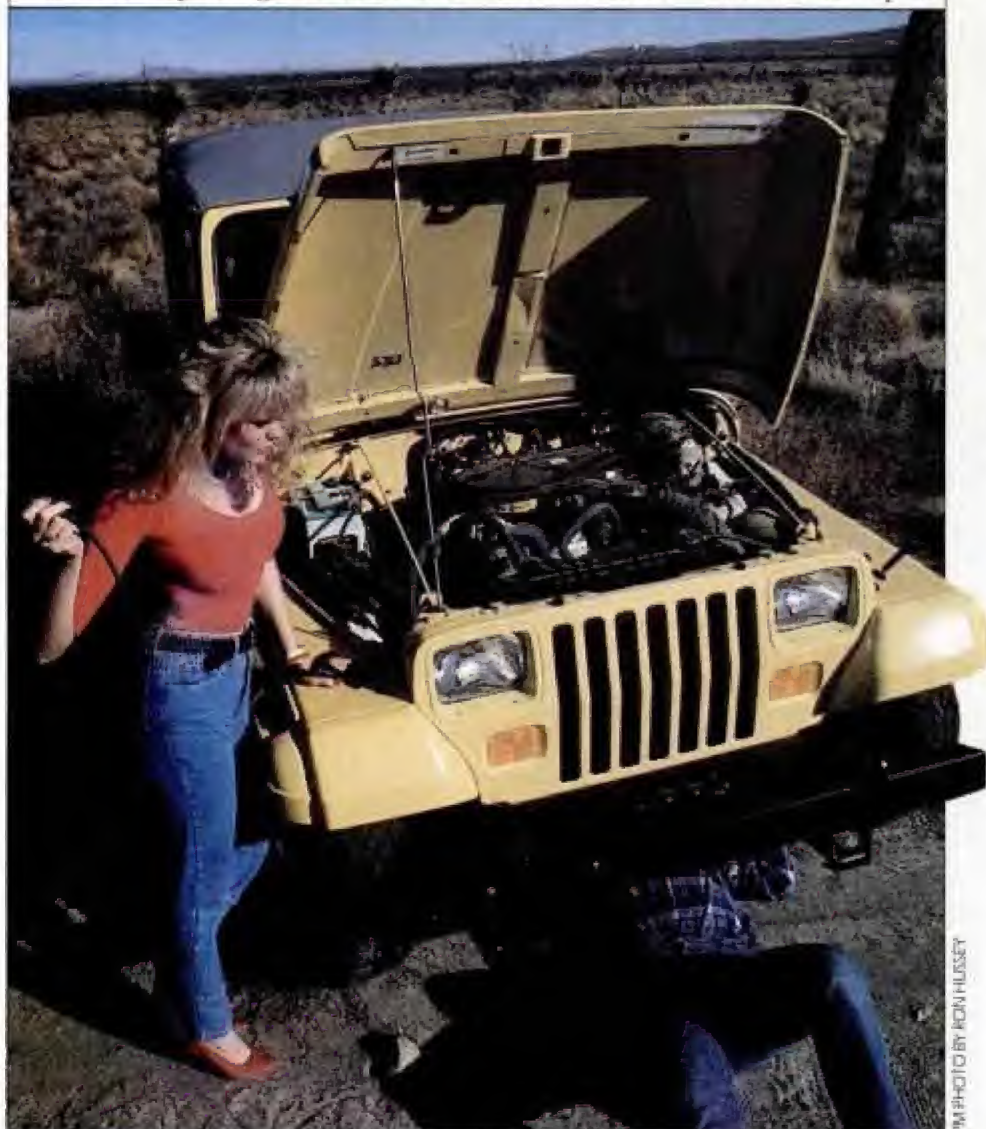


PHOTO BY RON HUSSEY

Even 100,000-mile accessory drive belts can break. A spare can spare you a long walk home.



## SPORT/UTILITY

home, though several companies sell outdoor survival/first-aid kits, in various sizes (prices range from about \$15 to \$100). **Prevail Survival Systems** [9395 Feron Blvd., Rancho Cucamonga, CA 91730, (714) 989-7773] and the American Red Cross offer such kits. A water jug—1 gallon is the absolute minimum, and a 5 gallon is better—is also essential for travel in desert areas.

■ **Heavy-duty jack**—Indispensable, regardless of climate or terrain. Original-equipment jacks are generally useless in sand/mud/snow situations, and those are precisely the situations where a 4-wheel-drive vehicle is likely to get stuck. A **Hi-Lift jack** (Hi-Lift Jack Co., 1627 S. Jefferson St., Bloomfield, IN 47424), or similar make, is the off-roader's best friend. It costs about \$35. It can be used as a conventional bumper jack, or as a winch, capable of lifting (or pulling) a 7000-pound vehicle 30 in. at a time. More often than not, that's all that's needed to get rolling again. A 12-in.-sq. piece of  $\frac{3}{4}$ -in. plywood should be kept handy to act as a base for the jack in sand or on soft ground—places where you're most likely to get stuck.

■ **Snatch strap**—Very valuable for extraction from sticky places. Don't confuse with a tow strap. A snatch strap, usually made from nylon, *stretches* and is designed to jerk a stranded vehicle out of the mud/snow in a slingshot manner. A tow strap, made from polypropylene or polyester materials, is designed specifically for towing, and has little elasticity. Companies like **Keeper Corp.**, (P.O. Box 675, Willimantic, CT 06226) and **Polaris** (1056-C Commerce St., San Marcos, CA 92069) specialize in both types. A 15- to 20,000-pound-capacity snatch strap (about \$20) is good for compact vehicles; 25- to 30,000-pound (about \$40) for full-size rigs.

■ **Tow hooks**—Standard on most new trucks and sport/utilities. However, usually there is only one—in the front, which may not wind up being in a spot suitable for hooking up to a winch or tow vehicle if you get stuck. It's better to have hooks at least fore and aft, and best to have them at all four corners. Bolt, do not weld, the hooks (about \$7 to \$10 a pair) to the frame of your vehicle.

■ **Short-handled shovel**—Saves wear and tear on hands and makes quick work of sand, mud and snow that can impair forward (or backward) travel. Military entrenching tools (about \$15) are handy, thanks to their collapsibility, although a regular shovel with its handle lopped off works and stows just as well.

■ **Engine helpers**—Include a can of WD40, or similar moisture-displacing aerosol, to quickly dry the inside of wet distributor caps. A spare set of accessory drive belts, or at least a replacement fan belt, should be behind the seat, too. Even 100,000-mile drive belts can be displaced or broken by rocks that find their way into the engine compartment.

■ **Hand tools**—Too often overlooked. A simple  $\frac{3}{8}$ -in. metric or standard socket set (from about \$25), a Phillips-head and standard screwdriver, a basic collection of open-end wrenches, a hammer, pliers and rolls of silver duct tape and mechanic's wire will be enough to handle most minor repairs, at least temporarily. A bar of soap is also useful, for stopping minor gas tank leaks.

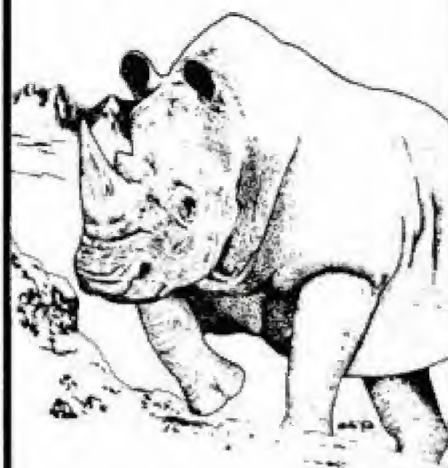
■ **Tire aids**—Be sure to have a fully inflated spare, a couple cans of tire sealant, a 4-way lug wrench, and a 12-volt, plug-in-type air compressor (from \$15 to \$50). A reliable pressure gauge is another plus. These items are useful for more than the mere reinflation of low or flat tires. For example, the best traction in sand is obtained by letting pressure down to 10 to 12 psi for maximum flotation. Without an air gauge, airing down—and later restoring—all of the tires to the same pressure level is an extremely difficult task.

■ **Fire extinguisher**—This inexpensive item can save plenty of cost, but is seldom considered until it's needed, and at that point it is too late. One 2½-pound Halon-filled extinguisher (about \$20) is best for vehicle use. Halon has no corrosive properties and doesn't have to be aimed directly at the base of the fire like dry-powder fire extinguishers.

■ **Electric winch**—Not an absolute necessity, but always a smart investment, even if you only use it once. Winches can be transferred to the next vehicle you buy. **Warn Industries** (13270 S.E. Pheasant Court, Milwaukee, OR 97222) makes a portable 4000-pound-capacity winch (about \$450) that is ideal for people who don't want a bumper-mounted unit. Portables are generally adequate for use with compact pickups and utes. Full-size sport/utility vehicle owners, however, will want a winch with 8000-pound capacity (from \$250 to \$1000). Finally, adding a tree-saver strap (about \$15), gloves, snatch block (to double, even triple, the winch's pulling efficiency—about \$20) and a short length of hefty chain and two clevis hooks (about \$5 each) will ensure a way of hooking the winch cable to the anchor point.

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SPORT/UTILITY

# DIRTY DRIVING



JEEP CHEROKEE LIMITED

The bedrock basics of successful off-road motoring.

BY LEN FRANK, West Coast Editor, with ROD MILLEN

**I**N THE GOSPEL of dirt driving, according to North American rally champion Rod Millen, the First Commandment is Keep Moving. The Second Commandment is Learn to Read the Terrain. After that, it's all supposed to be easy.

According to Millen, most trucks and sport/utilities are set up for driving on hard surfaces. Stopping in the dirt produces less weight transfer so you need more rear brake bias—the slower the going, the more rear brake required, the more slippery the terrain, the more rear brake. Which means that braking too hard (for the surface) will lock the front wheels and that in turn means loss of steering.

For speed on hard surfaces—tightly packed sand or dry fire roads, for instance—2wd is actually faster than 4wd, as long as there is not too much

power for one pair of drive wheels. As the surface loosens, though, 4wd comes into its own. A 2wd vehicle on dirt, says Millen, is a basic oversteerer: "You correct slides with opposite lock, balance the steering against the throttle. It's spectacular, it's fun, but it's slower than a smoothly steered 4wd through a loose corner. Four-wheel drive is more like front drive—lots of little corrections as you go faster, and moderate throttle."

Millen likes to use left-foot braking to offset excessive understeer with 4wd, and to stabilize the car (braking with the power on compresses the suspension). "Big knobby tires are perfect for deep muck, but for gravel or sand you'll want something smoother." And he reminds us that "too much tire" is a hindrance everywhere except on soft, loose sand.

Larger-than-standard antiroll bars are fine for pavement, especially with lowered suspension, but will keep the outside wheels from biting on dirt.

Millen also thinks that all trucks and sport/utilities are undershocked. He likes doubling up with stock-valve shocks rather than stiff singles—"less likely to fade and break shock mounts." Lift kits are out. Millen likes to keep the center of gravity as low as possible even if it means sacrificing a little ground clearance and wheel travel. He warns against sliding on rocky ground—tire strength is in the tread, not the sidewall.

"Anticipating conditions takes experience—remembering that there are times to go fast, times not to. Avoid wheelspin—when it starts, slip up a gear, read the terrain and, above all, keep it moving."

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The socket for the Ryobi chuck key makes key removal difficult. The Bosch drill uses a similar design but removal is easier.



The chuck key for the Porter-Cable tool is held securely in the metal battery strap. It's easy to remove but more difficult to replace.



Makita and Milwaukee both feature a clip that holds the chuck key shank securely. Removal and replacement are simple.

replacing the key is difficult.

The 5-position clutch, although smooth operating and producing a uniform torque progression, has a rather shallow range for a tool with such power. The highest setting only drove our 3-in. No. 12 test screw about 2 1/4 in. into the wood.

The only feature that this drill lacks is a high-speed range. With a top speed of 400 rpm, you may find that drilling small holes is slow going.

### Ryobi BD-1025VR

In any test like this, there must be at least one tool that falls pretty well dead center. And as far as our group is concerned, this accolade goes to the Ryobi BD-1025VR.

Although the drill has a somewhat chunky design, it's fairly compact for working in tight spaces. The 4-position clutch displayed a wide range of torque settings with an exceptionally wide variation between the high- and low-gear ranges to effectively provide eight torque settings.

In general, the controls work easily. However, Ryobi has opted for the under-the-housing clutch which can be annoying if you change settings frequently.

This tool has a handy compartment on top for holding two screwdriving bits. But, the chuck key is very difficult to remove from its storage slot.

### Sears 11132

Although the Sears tool was the lightest, smallest and the least heavy duty in construction and appearance, we repeatedly stumbled over one undeniable fact: This drill outruns every other drill for run-time performance except for the 12-volt Porter-Cable unit. It's also the least expensive.

While this drill does boast variable speed, we found that it was only truly variable under no-load conditions. When driving screws, it was often difficult to keep the bit turning unless full power was being applied. The Sears drill only had three clutch positions and they seemed appropriate for light-duty driving. To guard against any continuous heavy work that might damage the motor, it comes equipped with overload protection.

After hard use, the battery pack seemed hotter than other units and we often had to wait 20 minutes before recharging.

The general fit and finish doesn't quite come up to par with most of the other tools. But, if you plan to buy only one battery pack, you'll get the most from each charge with the Sears 11132.

### Skil 2735:04

This cordless drill was the second drill in our selection that boasted 12 volts. As such, it's a little lighter than the

### CLUTCH PERFORMANCE



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WIDE TORQUE RANGE TYPICAL OF MILWAUKEE, RYOBI, MAKITA AND BLACK & DECKER MODELS TESTED



HIGH SPEED



LOW SPEED

WIDE VARIATION IN CLUTCH PERFORMANCE BETWEEN HIGH- AND LOW-SPEED RANGES TYPICAL OF RYOBI, MAKITA AND SKIL

Chart indicates only general characteristics of clutch performance. Refer to text for more specific information on each tool.

### DRIVING POWER

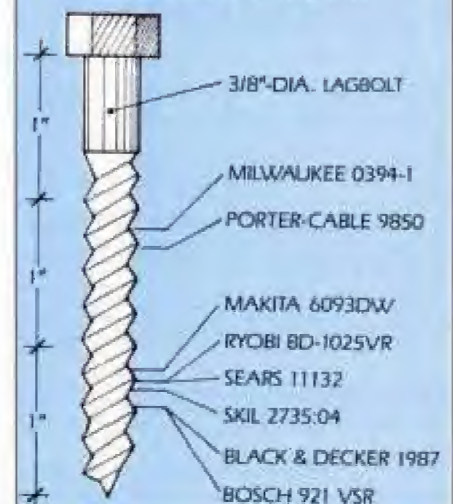
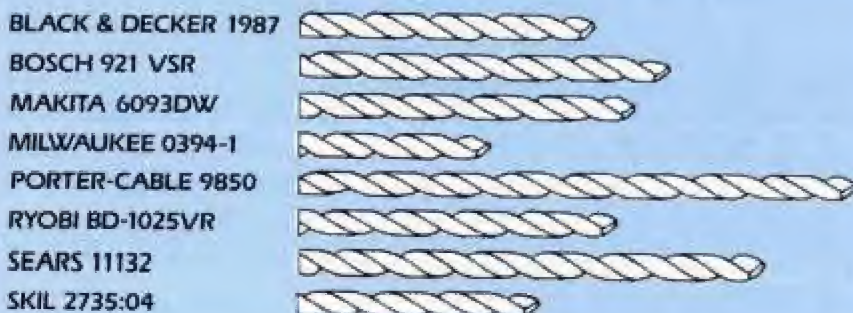


Chart indicates the maximum depth to which a 3/8-in.-dia. lagbolt could be driven into the edge of a 2x4 by each tool with a fully charged battery pack.

### RUN TIME



Run time is defined as the maximum number of completed operations in one charge cycle. Chart represents the accumulation of run-time tests over five testing cycles that include: boring holes with 1/4-in. spade bit, 1/2-in. auger bit, 1/32-in. twist bit and driving 3-in. No. 12 and 1 1/4-in. drywall screws. All tests began with a fully charged battery pack.



Porter-Cable 12 volt and it does have the advantage of two speed ranges and a high top speed of 1650 rpm.

It also is the only drill that you can buy that includes two battery packs in the kit. Considering that the packs average in price at about \$50, this is a sensible feature.

Unfortunately, the screws that we drove couldn't read the label on the drill that proclaimed 12-volt power—the unit did not seem to perform any differently than the 9.6-volt units.

The under-the-housing clutch dial performs adequately but is a little uncertain in feel. The clutch torque range is narrow and only suitable for light screw driving. To sink larger screws, you'll have to use direct drive. And, the FORWARD/REVERSE/OFF switch is too small for easy operation. However, the tool is comfortable to hold and, barring the fact that the 12-volt designation might indicate more power, the tool does do the job.

### Summing up

Choosing to buy any cordless drill is a compromise. The tools simply don't have the guts of the better plug-in  $\frac{3}{8}$ -in. drills. And, they don't perform well with spade bits which require a combination of high speed and torque.

If you plan to use a cordless for boring holes larger than  $\frac{3}{8}$  in., an auger bit is the better choice. Also, keep in mind that heavy jobs require extra power and you'll pay with frequent battery pack changes.

Before buying any cordless drill, give some thought to how you're going to use it and, of course, how much you care to spend. In terms of holes drilled per dollar, it's hard to beat the Sears 11132. The other tools *do* provide extra features and quality but you'll pay at least twice the price to get them.

Based on our findings, the Porter-Cable 9850 is the tool of choice where boring large holes or driving heavy screws are regular tasks. For general use, however, the Bosch 921 VSR looks like a winner due to its combination of performance, handling and heavy construction.

However, it's revealing that, after having become intimately familiar with all these tools, one drill was regularly chosen to handle the odd unofficial job that needed to be performed. The tool that our hands gravitated toward was the Milwaukee 0394-1. In terms of design, Milwaukee has achieved a balance that reflects the basic requirements of a cordless drill: easy handling, comfort and the power when you need it for the occasional heavy job.

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## THE RITES OF SPRING

(Continued from page 64)

ed price, which is expected to be about \$20,000. But viewed from the perspective of current Porsche prices, which is the not-unreasonable perspective VW would like very much for you to take, the Corrado can be perceived as something of a bargain.

—Tony Swan

## Mazda MX-5, RX-7

Just when you thought Mazda had gone to sleep, the boys from Hiroshima seem to have rediscovered the sports car. It's called the MX-5 Miata, and it's the embodiment of the old British sports car ethic—small, light, zippy and open.

The new roadster is about the same size as a Honda CRX, and the combination of its classic front-engine/rear-drive layout, 4-corner double wishbone suspension and 52/48 weight distribution promises to make it a nimble handler.

Power comes from Mazda's 1.6-liter 16-valve dohc Four—a healthy 116 hp at 6500 rpm—and the gearbox is a 5-speed manual. Brakes are discs all round, vented up front. Pricing was open to conjecture at press time, but educated guesses put it in the \$15,000 range.

Elsewhere, Mazda has made a number of small but telling improvements to the ever-popular RX-7. Most important are revisions to the rear suspension that produce significant gains in handling, particularly under braking. The engineers have also been busy inside the RX-7's rotary engine, increasing compression, reducing rotor inertia, tweaking the induction system and redesigning the turbocharger. The net here is a bump in both normally aspirated and turbocharged output—from 146 to 160 hp for the former, and from 182 to 200 for the latter.

—Tony Swan

## Nissan Axxess

Undeterred by the chilly reception accorded its Stanza wagon, Nissan is back with a slick new entry for the minivan derby. The Axxess sports the usual lengthy assortment of amenities we've come to expect in Japanese cars, but its most interesting feature is an optional 4-wheel-drive system with two viscous couplings.

The first of these, in the center differential, automatically varies front/rear torque split according to traction conditions. The second, in the rear, can vary torque split from side to side.

Power is supplied by Nissan's new sohc 2.4-liter 3-valve Four, the same engine used in the new 240SX.

—Tony Swan





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You learn how to install and service magnetic contacts and pressure mats... microwave, ultra-sonic, and passive infrared detectors... personal identification systems and electronic listening devices... even central station alarm systems and today's most sophisticated fire warning equipment. But that's not all.

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### **HOTLINE PHONE NUMBERS**

Since last July, we've had special telephone numbers here at Popular Mechanics that allow you to call our editors directly and easily. They're activated once a week, on Wednesdays, from 3 to 5 PM EST. All the editorial staff hotline phone numbers are listed here.

<b>HOME &amp; SHOP</b>		<b>AUTOMOTIVE</b>	
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<b>Tom Klenck</b>	(212) 265-7572	<b>Mike Allen</b>	(212) 265-7536
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		<b>Bill Hartford</b> , managing editor	(212) 265-7518

### **READER SERVICE BUREAU**

We have a Reader Information Bureau that is operational five days a week during regular business hours. Our Reader Service Bureau number is (212) 649-3127. Please call our Reader Service Bureau, *not our editors*, for information on back issues, reprints of articles, subscription inquiries, plans offers, etc. It will save us all time.

### **ELECTRONIC MAIL**

Now for the first time, you can communicate electronically with us if you have a personal computer and a modem.

You can call the PM computer any day between 6 PM and 8 AM (only) EST. The number is (212) 582-8369. Once you're on line, you can leave messages for specific editors, or direct inquiries and comments to a specific department. The department bulletin board also allows you to share your thoughts with other readers who call in.

New users will get an identification number and password that allow them to access the system. Simply set your communications software to 8 bits, no parity and one stop bit (8-N-1), and set the baud at 300 or 1200. If you're asking a specific question, allow a week before calling back for our answer.



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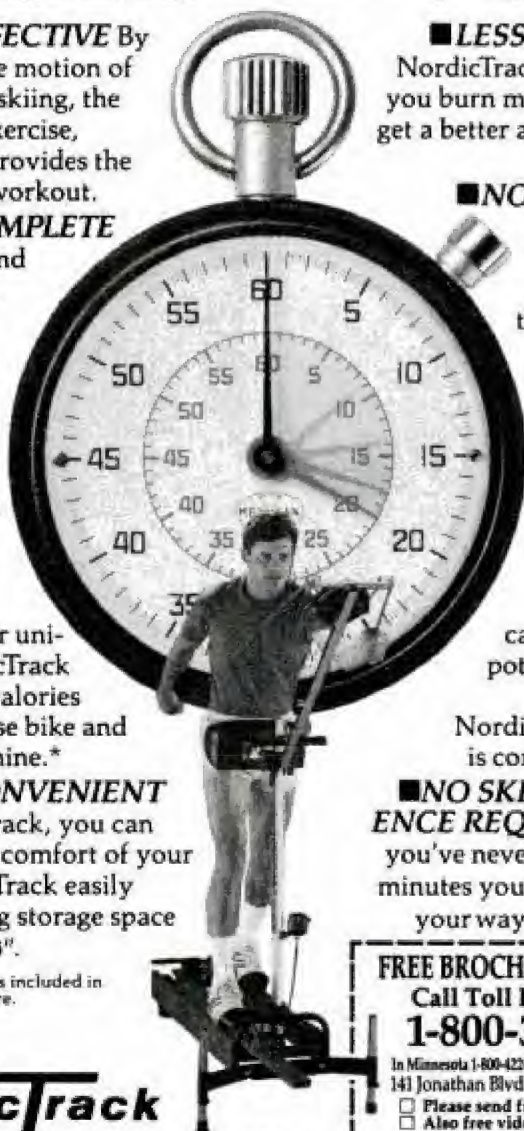
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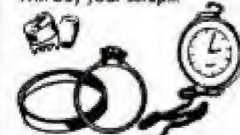
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Dear Friend,

I made one million dollars in 9 months. You may do better!

My name is John Wright. Not too long ago I was flat broke. I was \$31,000 in debt. The bank repossessed my car because I couldn't keep up with the payments. And one day the landlord gave me an eviction notice because I hadn't paid the rent for three months. So we had to move out. My family and I stayed at my cousin's place for the rest of that month before I could manage to get another apartment. That was very embarrassing.

Things have changed now. I own four homes in Southern California. The one I'm living in now in Beverly Hills is worth more than one million dollars. I own several cars, among them a brand new Mercedes and a brand new Cadillac. Right now, I have a million dollar line of credit with the banks and have certificates of deposit at \$100,000 each in my bank in Beverly Hills.

Best of all, I have time to have fun. To be me. To do what I want. I work about 4 hours a day, the rest of the day, I do things that please me. Some days I go swimming and sailing — shopping. Other days, I play racquetball or tennis. Sometimes, frankly, I just lie out under the sun with a good book. I love to take long vacations. I just got back from a two week vacation from — Maui, Hawaii.

I'm not really trying to impress you with my wealth. All I'm trying to do here is to prove to you that if it wasn't because of that money secret I was lucky enough to find that day, I still would have been poor or may be even bankrupt. It was only through this amazing money secret that I could pull myself out of debt and become wealthy. Who knows what would have happened to my family and me.

Knowing about this secret changed my life completely. It brought me wealth, happiness, and most important of all — peace of mind. This secret will change your life, too! It will give you everything you need and will solve all your money problems. Of course you don't have to take my word for it. You can try it for yourself. To see that you try this secret, I'm willing to give you \$20.00 in cash. (I'm giving my address at the bottom of this page.) I figure, if I spend \$20.00, I get your attention. And you will prove it to yourself this amazing money secret will work for you, too!

Why, you may ask, am I willing to share this secret with you? To make money? Hardly. First, I already have all the money and possessions I'll ever need. Second, my secret does not involve any sort of competition whatsoever. Third, nothing is more satisfying to me than sharing my secret only with those who realize a golden opportunity and get on it quickly.

This secret is incredibly simple. Anyone can use it. You can get started with practically no money at all and the risk is almost zero. You don't need special training or even a high school education. It doesn't matter how young or old you are and it will work for you at home or even while you are on vacation.

Let me tell you more about this fascinating money making secret:

With this secret the money can roll in fast. In some cases you may be able to cash in literally overnight. If you can follow simple instructions you can get started in a single afternoon and it is possible to have spendable money in your hands the very next morning. In fact, this just might be the fastest *legal* way to make money that has ever been invented!

This is a very safe way to get extra cash. It is practically risk free. It is not a dangerous gamble. Everything you do has already been tested and you can get started for less money than most people spend for a night on the town.

One of the nicest things about this whole idea is that you can do it at home in your spare time. You don't need equipment or an office. It doesn't matter where you live either. You can use this secret to make money if you live in a big city or on a farm or anywhere in between. A husband and wife team from New York used my secret, worked at home in their spare time, and made \$45,000 in one year.

This secret is simple. It would be hard to make a mistake if you tried. You don't need a college degree or even a high school education. All you need is a little common sense and the ability to follow simple, easy, step-by-step instructions. I personally know a man from New England who used this secret and made \$2 million in just 3 years.

You can use this secret to make money no matter how old or how young you may be. There is no physical labor involved and everything is so easy it can be done

## Here's what newspapers and magazines are saying about this incredible secret:

### The Washington Times:

*The Royal Road to Riches* is paved with golden tips.

### Los Angeles Herald Examiner:

We've all got to start somewhere... *The Royal Road to Riches* is the first step in the right direction!

### National Examiner:

John Wright has an excellent guide for achieving wealth in your spare time.

### Income Opportunities:

*The Royal Road to Riches* is an invaluable guide for finding success in your own back yard.

### News Tribune:

Wright's material is a MUST for anyone who contemplates making it as an independent entrepreneur.

### Success!

John Wright believes in success, pure and simple.

### Money Making Opportunities:

John Wright has a rare gift for helping people with no experience make lots of money. He's made many people wealthy.

### Hollywood Trade Press:

We have never heard of an advertiser offering to pay readers \$20 to try its program. Wright's willingness to do this convinces us that his money secret must really work.

### California Political Week:

... The politics of high finance made easy.

### Hollywood Citizen News:

He does more than give general ideas. He gives people a detailed A to Z plan to make big money.

### The Desert Sun:

Wright's *Royal Road to Riches* lives up to its title in offering an uncomplicated path to financial success.

whether you're a teenager or 90 years old. I know one woman who is over 65 and is making all the money she needs with this secret.

When you use this secret to make money you never have to try to convince anybody of anything. This has nothing to do with door-to-door selling, telephone solicitation, real estate or anything else that involves personal contact.

Everything about this idea is perfectly legal and honest. You will be proud of what you are doing and you will be providing a very valuable service.

It will only take you two hours to learn how to use this secret. After that everything is almost automatic. After you get started you can probably do everything that is necessary in three hours per week.

## PROOF

I know you are skeptical. That simply shows your good business sense. Well, here is proof from people who have put this amazing secret into use and have gotten all the money they ever desired. Their initials have been used in order to protect their privacy, but I have full information and the actual proof of their success in my files.

### 'More Money Than I Ever Dreamed'

"All I can say — your plan is *great*! In just 8 weeks, I took in over \$100,000. More money than I ever dreamed of making. At this rate, I honestly believe, I can make over a million dollars per year." A. F., Providence, R.I.

### '\$9,800 In 24 Hours!'

"I didn't believe it when you said the secret could produce money the *next morning*. Boy, was I wrong, and you were right! I purchased your *Royal Road to Riches*. On the basis of your advice, \$9,800 poured in, in less than 24 hours! John, your secret is incredible!" J. K., Laguna Hills, CA

### 'Made \$15,000 In 2 Months At 22'

"I was able to earn over \$15,000 with your plan — in just the past two months. As a 22 year old girl, I never thought that I'd ever be able to make as much money, as fast as I've been able to do. I really do wish to thank you, with all of my heart." Ms. E. L., Los Angeles, CA

### 'Made \$126,000 In 3 Months'

"For years, I passed up all the plans that promised to make me rich. Probably I am lucky I did — but I am even more lucky that I took the time to send for your

material. It changed my whole life. Thanks to you, I made \$126,000 in 3 months."

S. W., Plainfield, IN

### 'Made \$203,000 In 8 Months'

"I never believed those success stories... never believed I would be one of them... using your techniques, in just 8 months, I made over \$203,000... made over \$20,000 more in the last 22 days! Not just well prepared, but simple, easy, fast... John, thank you for your *Royal Road to Riches*!" C. M., Los Angeles, CA

### '\$500,000 In Six Months'

"I'm amazed at my success! By using your secret I made \$500,000 in six months. That's more than twenty times what I've made in any single year before! I've never made so much money in such short time with minimum effort. My whole life I was waiting for this amazing miracle! Thank you, John Wright!" R. S., McLean, VA

As you can tell by now I have come across something pretty good. I believe I have discovered the sweetest little money-making secret you could ever imagine. Remember — I guarantee it.

Most of the time, it takes big money to make money. This is an exception. With this secret you can start in your spare time with almost nothing. But of course, you don't have to start small or stay small. You can go as fast and as far as you wish. The size of your profits is totally up to you. I can't guarantee how much you will make with this secret but I can tell you this — so far this amazing money producing secret makes the profits from most other ideas look like peanuts!

Now at last, I've completely explained this remarkable secret in a special money making plan. I call it "*The Royal Road to Riches*". Some call it a miracle. You'll probably call it "*The Secret of Riches*". You will learn everything you need to know step-by-step. So you too can put this amazing money making secret to work for you and make all the money you need.

To prove this secret will solve all your money problems, don't send me any money, *instead postdate* your check for a month and a half from today. I guarantee not to deposit it for 45 days. I won't cash your check for 45 days before I know for sure that you are completely satisfied with my material.

## \$20.00 FREE!

There is no way you can lose. You either solve all your money problems with this secret (in just 30 days) or you get your money back *plus* \$20.00 in cash **FREE!**

Do you realize what this means? You can put my simple secret into use. Be able to solve all your money problems. And if for any reason whatsoever you are not 100% satisfied after using the secret for 30 days, you may return my material. And then I will not only return your original **UNCASHED CHECK**, but I will also send you an *extra \$20.00 cashiers check* just for giving the secret an honest try according to the simple instructions.

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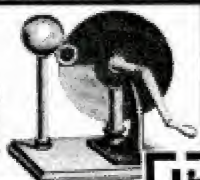
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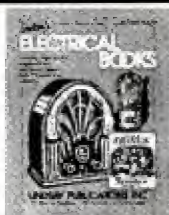


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My name is Gail Howard. You probably have heard of  
me. I actually developed a Lottery Winning System. It's  
so easy for anyone to win with, my System has made  
headline news around the country.

(I've been written up in the most important publications in  
the U.S.—*The New York Times*, *The Wall Street Journal*  
and *Newsweek*—as well as interviewed on popular TV  
Talk Shows such as "Good Morning America.")

The fact of the matter is, I have cracked the State Lottery  
Game.

Because you're reading this, you personally are invited  
to crack your State Lottery Game. (It's a snap with my  
System.) Here's what I'll send you FREE\*—so you can  
become an immediate Lottery winner.

**YOUR STATE LOTTERY WHEEL. YOUR WHEEL IS  
ABLE TO "PICK" THE WINNING NUMBERS—ALL OF  
THEM—FOR YOUR PARTICULAR STATE LOTTERY  
BECAUSE IT INCORPORATES MY SYSTEM.**

I know for sure my System works.

How do I know? When I tested my System here's what  
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tery win).

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tem to win big — and IMMEDIATELY won the Lot-  
tery 19 TIMES (collecting up to \$500,000.00 on a  
"good day").

4. Manuel Garcete, Leavelle Carter and James Shively  
used my System in their local Government Lotteries  
of New York, Washington, D.C., and California re-  
spectively—and IMMEDIATELY won (in order)  
\$661,000.00, \$804,000.00 and \$9,480,000.00.

5. My Winners Group has in it approximately 100 more  
smart people able to get hold of my System—use it—  
and make real Lottery money again and again and  
again. They ALL won their State Lotteries not just  
once—or twice—but THREE OR MORE TIMES. IN-  
CLUDING THREE KNOWN WINNERS WHO HIT  
THEIR STATE LOTTERIES 60 TO 216 TIMES  
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Now I want to give 100 other people a chance to win big  
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That is why I have published this notice. And why I will be  
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Millionaires. You are to be one of them. But you must  
respond to this notice without delay.

To get your complimentary STATE LOTTERY WHEEL  
return this free\* coupon right away.

(Why am I doing this? Because I have all the money I  
need. Frankly, this is my chance to become the most  
famous woman in America. To be known—by mil-  
lions—as the woman who beat the Lottery . . . and  
enabled others to beat it too. Since I don't need the  
money, I am giving away my STATE LOTTERY  
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(all of them) for the particular State Lottery Game I play. I under-  
stand you will give it to me WITHOUT CHARGE\* OR OBLIGA-  
TION. However, in return I promise to notify you as soon as I have  
won my first \$100,000.00.

\*Although there is no charge for this Lottery Winning System, you  
are asked to PLEASE ENCLOSE \$1 to help cover postage and  
handling.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

State (or Govt.) Lottery I play \_\_\_\_\_

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Send a FREE State Lottery Wheel to the following  
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City, State, Zip \_\_\_\_\_ Lottery \_\_\_\_\_

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## 144





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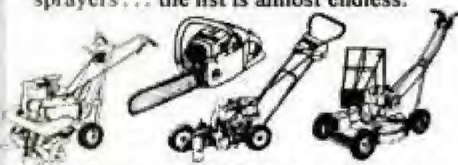
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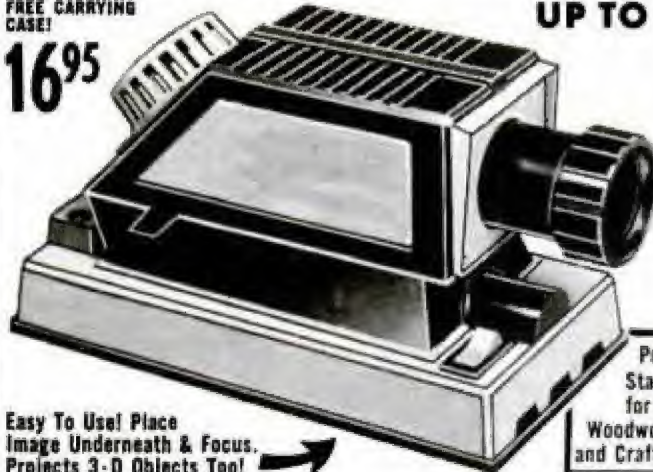
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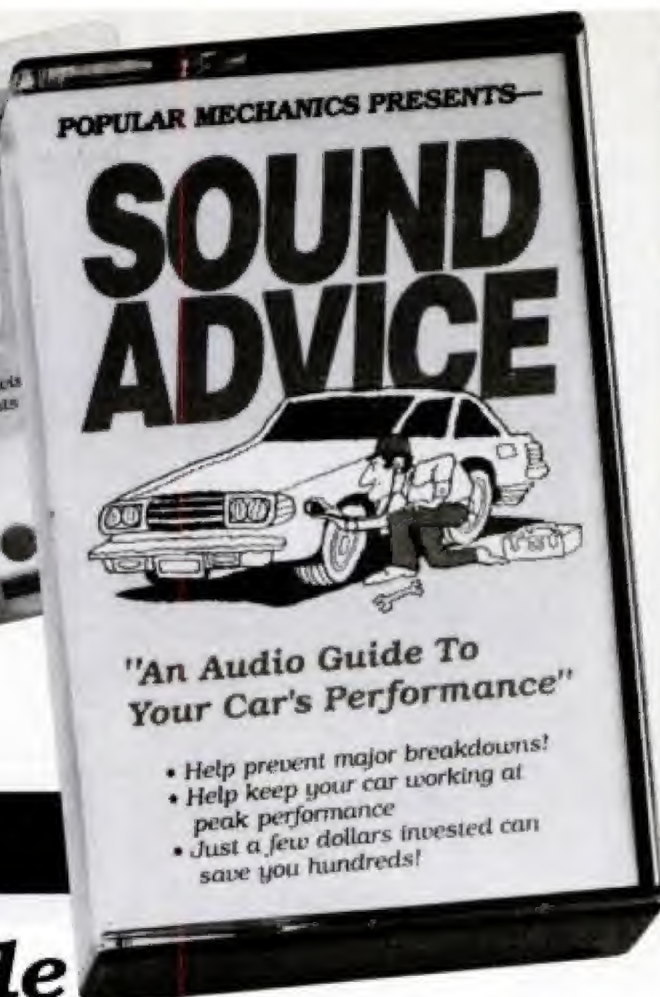
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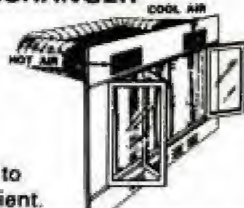
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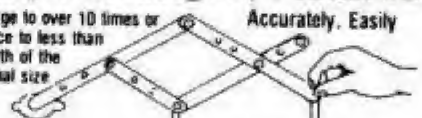
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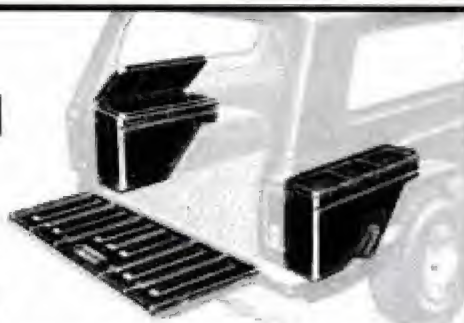
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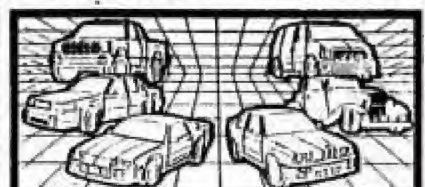
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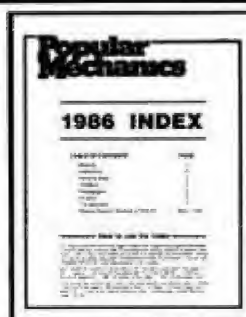
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